PHILIPPINE
JOURNAL
OF
SCIENCE

61
SEPT-DEC
1936

THE PHILIPPINE JOURNAL OF SCIENCE

VOLUME 61

SEPTEMBER TO DECEMBER, 1936

WITH 78 PLATES AND 5 TEXT FIGURES

MANILA
BUREAU OF PRINTING
1937

THE PHILIPPINE JOURNAL OF SCIENCE

Published by the Bureau of Science, Department of Agriculture and Commerce

[Entered at the Post Office at Manila, P. I., as second-class matter.]

CONTENTS

No. 1, September, 1936

[Issued November 6, 1936.]

No. 2, October, 1936

[Issued December 15, 1936.]

THE PHILIPPINE JOURNAL OF SCIENCE

VOL. 61 SEPTEMBER, 1936 No. 1

SOIL TYPES AND GROWTH OF ALGÆ IN BAÑGOS FISHPONDS

By D. Z. ROSELL and A. S. ARGÜELLES

Of the Bureau of Science, Manila

In the Philippines the commonest edible fish is the bañgos (*Chanos chanos* Forskål). The cultivation of this fish in ponds has been developed extensively, especially around Manila Bay.

Bañgos are essentially vegetarians. Their food consists principally of various species of algæ, known locally as *lumut*. When the supply of lumut is abundant the fish thrive and grow rapidly. Although hydrophytic in character these plants get part of their subsistence and anchorage from the soil.

This paper gives the results of a preliminary investigation to determine the types of soil found in some bañgos ponds and to ascertain their relation to the growth of the algæ.

HORIZONS OF FISHPOND SOILS

Soils that have water as the principal gross component were designated by Veatch as hydrosols. He classified such soils into four major morphologic horizons; namely, aqueous, subaqueous, and basal horizons in addition to the subbasal geologic substratum.

The hydrosols of the bañgos ponds around Manila Bay belong, in general, to the lacustrine group of shallow saline aqueous horizons. The depth of the aqueous horizon ranges from 20 centimeters in Cavite Province to 110 centimeters in Pampanga.

Aqueous horizon.—The first major horizon consists of the surface water, which is the "A_0" horizon of the normal soil

profile. Its importance lies in the fundamental requirements of many aquatic plants, which live almost entirely in a medium of water. Salinity, hardness, solids in suspension, and depth of the water are the most important factors in this zone.

Subaqueous horizon.—The second major horizon, the mud portion, is the "A" horizon in the normal soil profile. This is the anchorage place for most of the aquatic plants and a source of their nutrients. The physical properties and chemical composition of the soil in this zone naturally affect the growth of the plants.

Basal horizon.—The third major horizon is the "B" horizon in the normal soil profile. This is not as important as the subaqueous horizon. However, when the first and second horizons are shallow, its importance becomes quite significant.

Subbasal geologic substratum.—This is the "C" horizon in the normal soil profile. The character of the basal horizon is more or less dependent upon the geologic formation of this subbasal horizon.

SOIL TYPES OF SUBAQUEOUS HORIZONS

Field observations and the collection of soil samples of subaqueous horizons were made in four provinces bordering on Manila Bay; namely, Bataan, Pampanga, Rizal, and Cavite. All the samples were obtained from representative bañgos ponds by means of a post-hole digger. The growth of algæ, where the samples were taken, was carefully noted.

There were 6 samples collected from Bataan, 11 from Pampanga, 4 from Bulacan, 8 from Rizal, and 4 from Cavite, making a total of 33 soil samples. The number and location of the samples are recorded in Table 1. The description and relative growth of algæ are given in Table 2.

Soil samples of the subaqueous horizons of the different fishponds were classified according to definite soil types as follows:

Type 1.—Peaty clay either compact or matted in structure. Samples 11, 16, 17, 18, and 25.

Type 2.—Peaty clay either soft or fluid in consistency. Sample 23.

Type 3.—Slimy clay, slightly organic and gelatinous in consistency. Samples 9, 13, 14, 19, 21, and 33.

Type 4.—Clay-colloid, largely inorganic, containing either dark-colored, grayish green, or reddish mud. Samples 10, 15, 26, 27, 36, and 40.

TABLE 1.—*Location of soil samples of the subaqueous horizon.*

Sample No.	Place.	Pond No.	Remarks.
1	Sibacan, Balanga, Bataan	1	
3	do	2	
4	do	1	
6	do	3	
7	do	4	
8	Puerto Rivas, Balanga, Bataan		Near the sea.
9	Guagua, Pampanga	1	
10	do	1	
11	Sexmoan, Pampanga	1	
13	Betis, Pampanga	1	
14	do	1	
15	do	1	
16	Hacienda San Esteban, Macabebe, Pampanga	10	
17	do	10	
18	do	14	
19	do	3	
21	do		Lot 1-A.
23	Hacienda Sapang Cauayan, Hagonoy, Bulacan		Lot 3-A.
25	do		Lot 4-A.
26	do		Lot 2-A.
27	Bambang, Bulacan, Bulacan	1	
29	Caloocan, Rizal	4	
30	do	3	
31	do	5	
32	Longos, Malabon, Rizal	1	
33	Parañaque, Rizal	1	
34	do	1	
35	Las Piñas, Rizal	1	
36	do	1	
37	Bacoor, Cavite	1	
38	Dalahican, Noveleta, Cavite		By the sea.
40	do		Do.
42	do		Roadside.

Type 5.—Fine sandy mud, sand-organic matter admixed. Samples 4, 6, 7, 32, 35, 38, and 42.

Type 6.—Sandy mud, sand-shell admixed. Samples 1, 3, 8, 29, 30, 31, and 37.

Type 7.—Sand, clean sand compact. Sample 34.

There is a wide range of texture and consistency in the subaqueous horizons of the different fishponds around Manila Bay. Fishponds in Pampanga and Bulacan Provinces, along Pampanga and Guagua Rivers, have subaqueous horizons of fine texture consisting mostly of clay with decayed trunks, leaves, and roots of the nipa palm. This is particularly true of the ponds at the Hacienda San Esteban of the Ayala Company and the Hacienda Sapang Cauayan of the La Tondeña Company, which are in a nipa-palm region.

TABLE 2.—*Descriptions of samples of bañgos-pond soils and the growth of the algæ where the samples were collected.*

Sample No.	Depth of aqueous horizon.	Depth of subaqueous horizon.	Description of subaqueous horizon.	Description of basal horizon.	Growth of algæ.
	cm.	*cm.*			
1	0– 50	50– 82	Brown and nearly black; very fine sandy mud, largely inorganic	Dark gray sand	Few.
3	0– 60	60– 88	Very dark brown; very fine sandy mud, largely inorganic	Dar'- gray muddy sand	Do.
4	0– 60	60– 88	Black; very fine sandy peat, mud; with few remains of nipa palm	Dark muddy sand	Abundant.
6	0– 60	60–102	Very dark gray; very fine sandy mud; largely inorganic	Black sand	Do.
7	0– 52	52–122	Dark gray; very fine sandy mud; largely inorganic	Dark gray muddy sand	Do
8	0– 48	48– 84	Dark brown to black; peaty mud with partially decomposed nipa palm; largely inorganic.	Dark brown sandy mud	Few.
9	0– 64	64–102	Black; muddy clay; largely inorganic with marine shells	Very dark brown to black clay soil	Very abundant.
10	0– 40	40– 74	Very dark brown to black muddy silty clay with marine shells	Dark brown muddy clay	Abundant.
11	0– 46	46– 88	Dark brown to nearly black; peaty and muddy clay; partially decomposed nipa palm.	Dark gray silty clay mud	Very abundant.
13	0– 38	38– 80	Gray to dark gray slimy muddy clay	Dark gray muddy clay	Do.
14	0– 45	45– 81	Black with gray muddy clay; largely inorganic	Gray muddy clay	Do.
15	0– 70	70–102	Dark brown to dark gray muddy clay soil; largely inorganic	Dark gray muddy clay	Abundant.
16	0–110	110–150	Dark gray peaty mud; mostly of decomposed nipa palm	Reddish brown peaty mud; largely of nipa leaves.	Very abundant.
17	0– 65	65–120	Reddish brown peaty and muddy clay loam with decomposed nipa palm.	Reddish brown peaty muddy clay	Do.
18	0– 35	35–100	Dark brown to reddish brown peaty mud with marine shells and decayed roots and leaves of nipa palm.	Reddish brown peaty mud; largely decayed roots and leaves.	Do.
19	0– 55	55–105	Black slimy and muddy clay largely organic with marine shells compact.	Dark gray silty mud with decayed leaves and roots of nipa palm.	Do.
21	0– 70	70– 90	Black and gray slimy muddy clay; largely organic with marine shells compact.	Reddish brown peaty mud largely organic; decayed roots and leaves.	Do.
23	0– 60	60–105	Black peaty mud; largely of decayed remains of nipa palm	Mixture of gray and reddish brown peat mud with decayed remains of nipa palm.	Abundant.
25	0– 70	70– 90	Reddish brown slimy muddy clay with decayed remains of nipa palm.	Reddish brown peaty mud largely of decayed nipa-palm remains.	Very abundant.
26	0– 40	40– 85	Black slimy mud with plenty of marine shells	Brown mud largely inorganic	Abundant.

27	0– 25	25– 57	Very dark brown and black muddy clay; largely inorganic	Dark brown clay largely inorganic	Do.
29	0– 55	55–100	Very dark brown to black; very fine sandy mud with marine shells	Brown sandy mud with few marine shells	Few.
30	0– 50	50– 92	Dark gray to black; very fine sandy mud, largely inorganic with marine shells.	Pale brown clay mud	Do.
31	0– 43	43– 98	Dark gray very fine sandy mud with marine shells	Dark brown muddy sand	Do.
32	0– 48	48– 76	Dark gray to dark green sandy mud; compact	Gray muddy sand	Do.
33	0– 42	42–104	Black slimy muddy clay; largely inorganic; compact	Dark brown sandy mud	Very abundant.
34	0– 35	35– 65	Dark gray muddy sand with marine shells	Dark brown sand with marine shells	Very few.
35	0– 45	45– 71	Very dark gray mud; largely inorganic	Dark brown muddy sand	Few.
36	0– 35	35– 72	Very dark gray to nearly black slimy muddy clay	Gray muddy clay	Abundant.
37	0– 45	45– 85	Black slimy sandy mud; largely inorganic	Dark brown muddy sand	Few.
38	0– 40	40–112	Very dark gray to nearly black; very fine slimy sandy muddy clay loam, compact.	Dark gray mud	Abundant.
40	0– 40	40– 90	Black; very fine slimy muddy clay; largely inorganic	Dark gray peaty mud	Do.
42	0– 20	20– 32	Black slimy sandy mud, compact	Dark gray to black sand	Do.

TABLE 3.—*Average mechanical analyses of different types of subaqueous horizon and the growth of algæ.*

Type of subaqueous horizon.	Coarse sand, 2 to 0.22 mm.	Medium sand, 0.22 to 0.14 mm.	Fine sand, 0.14 to 0.07 mm.	Very fine sand, 0.07 to 0.05 mm.	Silt, 0.05 to 0.005 mm.	Clay, 0.005 mm.	Solution loss. [a]	Growth of algæ.
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	
1	0.7	7.1	4.4	7.4	17.4	36.6	26.4	Very abundant.
2	0.0	0.1	0.2	10.6	33.9	33.0	22.2	Abundant.
3	2.9	6.6	6.1	11.4	20.5	35.9	16.6	Very abundant.
4	6.3	4.0	2.6	7.7	20.6	47.6	11.2	Abundant.
5	23.5	9.0	8.5	14.7	12.2	23.4	8.7	Do.
6	19.2	7.5	7.1	23.6	12.9	20.1	9.6	Few.
7	22.9	25.5	18.6	8.1	9.1	9.6	6.2	Very few.

[a] The solution loss is obtained by treating the sample with hydrogen peroxide and washing.

TABLE 4.—*Average chemical analyses of different types of subaqueous horizon and the growth of algæ.*

Type of subaqueous horizon.	Nitrogen (N).	Phosphoric anhydride (P_2O_5).	Potash (K_2O).	Organic matter.[a]	Growth of algæ.
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	
1	0.346	0.136	0.948	24.48	Very abundant.
2	0.248	0.176	0.617	15.56	Abundant.
3	0.363	0.107	0.826	16.11	Very abundant.
4	0.205	0.117	0.760	12.88	Abundant.
5	0.119	0.086	0.861	9.30	Do.
6	0.098	0.107	0.767	7.78	Few.
7	0.051	0.107	0.799	5.75	Very few.

[a] Organic matter was obtained by the loss on ignition.

Bataan, Rizal, and Cavite Provinces have fishponds located near the sea with subaqueous horizons of varying texture depending upon the distance of the pond from the seashore and the type of soil in the immediate vicinity.

The subaqueous horizons of fishponds in Balanga, Bataan Province, consist mostly of fine sandy mud. In Malabon and Caloocan, Rizal Province, they are composed chiefly of fine sand. In Parañaque and Las Piñas, Rizal, they are a sandy mud that is black to dark gray in color; and in Bacoor and Noveleta, Cavite, they are also sandy mud.

EXPERIMENTAL PROCEDURE

Mechanical and chemical analyses were made of the individual soil samples included in each soil type. The analytical results of the samples included in each type were then averaged in order to get the mean results for each particular type.

Average mechanical analyses of the different types of subaqueous horizons are given in Table 3, and in Table 4 are given the average chemical analyses. Included in these tables are also notes on the growth of algæ corresponding to various types of subaqueous horizons.

The mechanical analyses were made in accordance with the method of Olmstead, Alexander, and Middleton. The methods of the Association of Official Agricultural Chemists were used for the chemical analyses. The elements determined were nitrogen, phosphorus, and potassium. Organic matter was ascertained by the loss on ignition.

SUMMARY

A preliminary investigation of the soils of some fishponds bordering on Manila Bay was carried out.

Data from the mechanical and chemical analyses (Tables 3 and 4) indicate that, in general, algæ seem to grow very abundantly in types of subaqueous horizons that have a high-solution loss and a high content of clay, nitrogen, and organic matter. Types that are deficient in these characteristics generally have very few algæ.

BIBLIOGRAPHY

ADAMS, W., H. R. MONTALBAN, and C. MARTIN. Cultivation of bañgos in the Philippines. Philip. Journ. Sci. **47** (1932) 1.

VEATCH, J. O. Classification of water soils is proposed. Mich. Agr. Exp. Sta. Qr. Bull. **14** (1931).

VEATCH, J. Q. Aquatic vegetation in relation to soils. Am. Soil Sur. Assoc. Bull. **13** (1932) 11.

OLMSTEAD, L. B., L. T. ALEXANDER, and H. E. MIDDLETON. A pipette method of mechanical analysis of soils based on improved dispersion procedure. U. S. Dept. Agr. Tech. Bull. **170** (1930).

Official and Tentative Methods of Agricultural Analysis. Assoc. Off. Agr. Chem. (1930).

PIETERS, A. J. The plants of western Lake Erie, with observations on their distribution. U. S. Fish Comm. Bull. **21** (1901) 57.

EMERSON, P. Principles Of Soil Technology (1930).

DIATOMS FROM KIZAKI LAKE, HONSHU ISLAND NIPPON

By B. W. SKVORTZOW
Of Harbin, Manchoukuo

SIXTEEN PLATES

In presenting this list of the diatoms that I found in Kizaki Lake, Shinano Province, Honshu Island, Nippon, I wish to offer some general results of the investigation.

The diatom material was collected in July, 1927, by Mr. K. Kiuchi, and sent to me through the kindness of Prof. Dr. T. Kawamura, director of the Zoölogical Institute, College of Science, Kyoto Imperial University. The material consisted of a glass tube with mud from the lake. The crude material was first examined under the microscope, by the use of magnifying powers ranging from 100 to 600 diameters, and only a few diatoms were discovered. When the mud was prepared for accurate investigation I found thousands of siliceous algæ. The material was boiled in commercial hydrochloric acid for one-half hour. The acid when cold was decanted, and the residue washed with water to get rid of the resultant salts. After a few days the material was boiled in concentrated commercial sulphuric acid for one-half hour, after which powdered potassium chlorate was slowly added to the boiling acid until the black color gave place to yellow. A week was spent in removing the traces of acids and salts from the material. The prepared diatoms were preserved in alcohol. The diatom material was mounted in coumarone-piperin and mercuric iodide (HgI_2), proposed by Dr. R. W. Kolbe. I have examined a hundred microscopic slides with apochromat 2 mm E. Leitz, Wetzlar, and compensating oculars 6, 8, and 12. Half a year was spent in the study of this collection.

The diatom flora of Kizaki Lake is rich. The slides examined yielded 338 forms, a list of which is given below. Diatoms, especially those living in fresh water, are known to be very cosmopolitan in their habitats. Nevertheless, there are certain species characteristic of alpine and Arctic regions, and others

of warm climates. The diatom flora of Kizaki Lake is largely represented by various species of *Melosira* and *Cyclotella* and, especially, naviculoid forms, which are abundant in colder waters. Northern, Arctic, and alpine species predominate; tropical elements are richly represented. The alpine and Arctic diatoms are the following:

Melosira distans.
Melosira italica var. *valida.*
Cyclotella glomerata.
Diatoma hiemale.
Eunotia praerupta.
Eucocconeis flexella.
Achnanthes lanceolata var. *elliptica.*
Frustulia rhomboides.
Neidium bisulcatum.
Neidium Kozlowi.
Diploneis marginestriata.
Navicula Rotaeana.
Pinnularia leptosoma.
Cymbella naviculiformis.
Cymbella aequalis.
Cymbella heteropleura var. *minor.*
Cymbella gracilis.
Cymbella alpina.
Gomphonema quadripunctatum.
Rhopalodia parallela.

It is interesting to note that *Neidium Kozlowi* is reported from central Asia and *Gomphonema quadripunctatum* from Baikal Lake, northern Europe, and Mongolia.

To tropical elements must be referred the following species:

Melosira americana.
Melosira undulata var. *Normanni.*
Actinella brasiliensis.
Eunotia tropica.
Neidium oblique-striatum var.
Navicula confervacea.
Amphora delphinea.
Cymbella turgidula.
Cymbella turgida.
Gomphonema gracile.
Gomphonema Berggrenii.
Epithemia cistula var. *lunaris.*
Surirella Terryana.

Such diatoms as *Melosira americana, Neidium oblique-striatum,* and *Surirella Terryana* occur in South America. A peculiar diatom, *Actinella brasiliensis,* is still living in Nippon, occurs in Demerara River in Guiana, South America, and is known as a fossil in the southern part of France. *Gomphonema Berggrenii* was described from New Zealand; *Epithemia cistula* is living in India and southern China, and is reported as a fossil in Hungary.

The brackish-water species from Kizaki waters are represented by the following:

Fragilaria construens var. *subsalina.*
Achnanthes Hauckiana.
Rhoicosphenia curvata.
Diploneis Smithii var.
Navicula protracta.
Navicula holophila forma *minor.*
Navicula salinarum var.
Pinnularia viridis var. *leptogongyla.*

Large new forms of *Diploneis Smithii* found in Kizaki Lake seem to belong to alpine species. The type of *Diploneis Smithii*

is known from brackish waters. Two fossil diatoms were discovered in Kizaki Lake. These are *Pinnularia lignitica,* originally reported from Nippon lignite, and *Cymbella sinuata* var. *antiqua,* from Hungary.

The endemic diatoms in Kizaki Lake are represented by the following species:

Ceratoneis arcus var. *Hattoriana.*
Synedra japonica.
Achnanthes pinnata var. *japonica.*
Navicula subdicephala.
Navicula globulifera.
Pinnularia divergens var. *japonica.*
Pinnularia lignitica.
Pinnularia platycephala var. *Hattoriana.*
Pinnularia montana var.
Cymbella japonica.
Gomphonema vastum.
Gomphonema lingulatum.
Nitzschia interrupta.
Surirella robusta forma *lata.*
Surirella Capronii var. *obtusa.*
Surirella Pantoscekii.

All these diatoms were described by Reichelt, Meister, Hustedt, and Cleve. The present list contains the names of 94 new diatoms, and they are also endemic to this country. This note is illustrated with drawings by the author, which will be of use in future investigations.

MELOSIRA VARIANS C. A. Ag. Plate 2, fig. 33.

Melosira varians C. A. Ag., FR. HUSTEDT, Bacillar. (1930) 85, fig. 41.

Frustules 0.015 mm in breadth. Not common in Kizaki Lake. Known from Nippon.

MELOSIRA GRANULATA (Ehr.) Ralfs. Plate 1, fig. 8.

Melosira granulata (Ehr.) Ralfs, FR. HUSTEDT, Bacillar. (1930) 87, fig. 44.

Frustules 0.01 mm in breadth. Rare. Known from Aokiko Lake.

MELOSIRA DISTANS (Ehr.) Kütz. Plate 1, fig. 10.

Melosira distans (Ehr.) Kütz., FR. HUSTEDT, Bacillar. (1930) 92–93, fig. 53.

Frustules 0.005 to 0.007 mm in breadth with fine puncta 15 in 0.01 mm. Common in Kizaki and Aokiko Lakes. Known from alpine waters.

MELOSIRA DISTANS (Ehr.) Kütz. var. LIRATA (Ehr.) Bethge. Plate 10, fig. 12.

Melosira distans (Ehr.) Kütz. var. *lirata* (Ehr.) Bethge, FR. HUSTEDT, Bacillar. (1930) 93, fig. 55.

A variety with more robust frustules 0.006 to 0.007 mm in breadth. Striæ 10 in 0.01 mm. Rather common in Kizaki

Lake. The variety *africana* O. Mull., found by Fr. Hustedt in Aokiko Lake, was not seen in Kizaki Lake.

MELOSIRA AMERICANA Kütz. Plate 1, fig. 1.

Melosira americana KÜTZING, Bacillar (1865) 55, pl. 30, fig. 69; FR. HUSTEDT, Bacillar. a. d. Aokikosee in Japan 156, pl. 5, fig. 8.

Frustules cylindrical, barrel-shaped, 0.012 to 0.015 mm in diameter, with spinous junctions. This species is fairly abundant in Kizaki Lake. *Melosira americana* was described by Kützing from tropical America in 1865 and found by Fr. Hustedt in Aokiko Lake in Nippon.

MELOSIRA BINDERANA Kütz. Plate 1, figs. 3 and 4; Plate 10, fig. 6.

Melosira Binderana Kütz., FR. HUSTEDT, Bacillar. (1930) 86–87, fig. 43.

A distinct species with small, slightly siliceous frustules. Breadth, 0.004 to 0.005 mm. Common in Kizaki Lake. Known from Europe and Asia.

MELOSIRA UNDULATA (Ehr.) Kütz. var. NORMANNI Arnott. Plate 1, fig. 2.

Melosira undulata (Ehr.) Kütz. var. *Normanni* Arnott, VAN HEURCK, Synopsis pl. 90, fig. 7.

A very robust species with frustules 0.027 to 0.03 mm in breadth. This tropical diatom is known from Aokiko Lake in Nippon, southern China, and Java, and is a fossil in Europe.

MELOSIRA ITALICA (Ehr.) Kütz. var. TENUISSIMA (Grun.) O. Mull. Plate 1, fig. 6.

Melosira italica (Ehr.) Kütz. var. *tenuissima* (Grun.) O. Mull., VAN HEURCK, Synopsis pl. 88, fig. 11.

A delicate form with frustules 0.004 mm in breadth. Common in Kizaki Lake.

MELOSIRA ITALICA (Ehr.) Kütz. var. VALIDA Grun. Plate 1, fig. 7.

Melosira italica (Ehr.) Kütz. var. *valida* Grun., FR. HUSTEDT, Bacillar. (1930) 94, fig. 51.

A distinct form with frustules 0.02 to 0.03 mm in breadth and 0.027 to 0.03 mm in length. Puncta 12 in 0.01 mm. Very common in Kizaki and Aokiko Lakes in Nippon. Known from subalpine regions.

MELOSIRA ITALICA (Ehr.) Kütz. subsp. SUBARCTICA O. Mull. Plate 1, fig. 5.

Melosira italica (Ehr.) Kütz. subsp. *subarctica* O. Mull., FR. HUSTEDT, Bacillar. (1930) 92, fig. 52.

Frustules in long filaments, 0.0076 to 0.008 mm in breadth. Striæ 18 in 0.01 mm. Puncta 24 in 0.01 mm. Known from Nippon.

CYCLOTELLA STELLIGERA Cleve and Grun. Plate 1, fig. 11.

Cyclotella stelligera Cleve and Grun., FR. HUSTEDT, Bacillar. (1930) 100, fig. 65.

A distinct species with a ring of alveoli in the center of the valve. Diameter of the valve 0.012 mm. Striæ 13 in 0.01 mm. Not common. Known from Aokiko Lake.

CYCLOTELLA GLOMERATA Bachmann fo. NIPPONICA fo. nov. Plate 1, fig. 12.

A little species with circular valve consisting of a hyaline central area, one-half the diameter of the valve, and a rim of transverse striæ. Diameter of the valve, 0.0036 to 0.004 mm. Striæ 18 in 0.01 mm. Differs from the type in its coarser striæ. *Cyclotella glomerata* is known from subarctic lakes of Europe.

CYCLOTELLA MENEGHINIANA Kütz. var. NIPPONICA var. nov. Plate 8, fig. 14.

This new variety differs from the type by a ring of scattered beads near the marginal rim of the transverse striæ. Diameter of the valve, 0.012 mm. Striæ robust, 7 in 0.01 mm. Occasional in Kizaki Lake.

CYCLOTELLA COMTA (Ehr.) Kütz.

Cyclotella comta (Ehr.) Kütz., VAN HEURCK, Synopsis pl. 92, figs. 16–23.

Valve circular; consisting of a large central area, two-thirds the diameter of the valve and a rim one-third the valve diameter; the former with puncta finely distributed over the entire valve in rows radial from the center. Rim ornamented with delicate transverse striæ. Diameter of the valve, 0.001 to 0.045 mm. Very common in Kizaki Lake. Known from Aokiko Lake.

CYCLOTELLA COMTA (Ehr.) Kütz. var. PAUCIPUNCTATA Grun. Plate 12, fig. 2.

Cyclotella comta (Ehr.) Kütz. var. *paucipunctata* Grun., VAN HEURCK, Synopsis pl. 93, fig. 20.

A variety with a small central area, with scattered beads forming a star in the center. Diameter of the valve, 0.012 mm. Striæ 18 in 0.01 mm. Very rare. Known from Aokiko Lake in Nippon.

CYCLOTELLA COMTA (Ehr.) Kütz. fo. PARVA fo. nov. Plate 8, fig. 13.

Differs from the type in its smaller valve. Diameter of the valve, 0.0042 to 0.006 mm. Common in Kizaki Lake.

STEPHANODISCUS ASTRAEA (Ehr.) Grun.

Stephanodiscus astraea (Ehr.) Grun., VAN HEURCK, Synopsis (1880–1881) pl. 95, figs. 5, 6.

A common diatom in Kizaki Lake. Known from Aokiko Lake.

TABELLARIA FLOCCULOSA (Roth.) Kütz. Plate 1, fig. 16.

Tabellaria flocculosa (Roth.) Kütz., FR. HUSTEDT, Bacillar. (1930) 123–124, fig. 101.

Valve linear with median inflation larger than the terminal. Common in Kizaki Lake.

TABELLARIA FENESTRATA (Lyngb.) Kütz. Plate 1, fig. 35.

Tabellaria fenestrata (Lyngb.) Kütz., FR. HUSTEDT, Bacillar. (1930) 122–123, fig. 99.

Valve linear, gibbous in the middle. Ends capitate. Length, 0.068 mm; breadth, 0.0045. Striæ 18 in 0.01 mm. Uncommon in Kizaki Lake.

DIATOMA VULGARE Bory var. LINEARIS Grun. Plate 10, fig. 7.

Diatoma vulgare Bory var. *linearis* Grun., A. SCHMIDT, Atlas Diatom. pl. 265, figs. 11–17.

Valve linear with slightly truncate end. Length, 0.024 mm; breadth, 0.0034. Striæ 15 in 0.01 mm. Not common.

DIATOMA HIEMALE (Lyngb.) Heiberg. Plate 1, fig. 24; Plate 2, fig. 34; Plate 10, fig. 13.

Diatoma hiemale (Lyngb.) Heiberg, FR. HUSTEDT, Bacillar. (1930) 129, fig. 115.

Valve lanceolate, obtuse. Length, 0.02 to 0.03 mm; breadth, 0.006 to 0.005. An alpine species.

DIATOMA HIEMALE (Lyngb.) Heiberg var. MESODON (Ehr.) Grun. Plate 1, fig. 13; Plate 9, fig. 18; Plate 10, fig. 25.

Diatoma hiemale (Lyngb.) Heiberg var. *mesodon* (Ehr.) Grun., FR. HUSTEDT, Bacillar. (1930) 129, fig. 116.

Valve broad elliptic. Length, 0.012 to 0.017 mm; breadth, 0.007. An alpine diatom reported from Aokiko Lake.

MERIDION CIRCULARE Agardh. Plate 1, fig. 19.

Meridion circulare Agardh, FR. HUSTEDT, Bacillar. (1930) 130–131, fig. 118.

Valve clavate. Length, 0.032 mm; breadth, 0.0045. Costæ 4 in 0.01 mm. Not common. Known from springs and mountain streams.

MERIDION CIRCULARE Agardh var. CONSTRICTA (Ralfs) Van Heurck. Plate 10, fig. 28.

Meridion circulare Agardh var. *constricta* (Ralfs) Van Heurck, FR. HUSTEDT, Bacillar. (1930) 131, fig. 119.

Valve clavate with constricted capitate ends. Length, 0.03 mm; breadth, 0.004. Not common.

OPEPHORA MARTYI Heribaud. Plate 2, fig. 27; Plate 13, fig. 3.

Opephora Martyi Heribaud, FR. HUSTEDT, Bacillar. (1930) 132–133, fig. 120.

Valve broad-ovate, or elongate, rounded at one end and acute at the other. Length, 0.0076 to 0.012 mm; breadth, 0.0025 to 0.003. Costæ 12 in 0.01 mm. Common in Kizaki Lake. Known from Aokiko Lake.

OPEPHORA MARTYI Heribaud var. **ROBUSTA** var. nov. Plate 12, fig. 8; Plate 13, fig. 10.

Valve robust; convex, attenuate towards the ends. Ends broad-obtuse. Length, 0.023 to 0.042 mm; breadth, 0.0068 to 0.009. Costæ 5 to 6 in 0.01 mm. Common.

OPEPHORA MARTYI Heribaud var. **ELONGATA** var. nov. Plate 13, fig. 12.

Valve long-ovate. One end much broader than the other. Length, 0.015 mm; breadth, 0.005. Costæ 9 in 0.01 mm. A distinct variety.

OPEPHORA OKADÆ sp. nov. Plate 12, fig. 6.

Valve claviform with subtruncate and usually constricted apex. End attenuate, constricted and capitate. Central area linear. Length, 0.024 to 0.03 mm; breadth, 0.0042 to 0.005. Costæ 7 in 0.01 mm. A species distinct from *O. Martyi* Heribaud. Named in honor of Dr. Yoshikazo Okada, of Tokyo.

CERATONEIS ARCUS Kütz. var. **HATTORIANA** Meister. Plate 1, fig. 38.

Ceratoneis arcus Kütz. var. *Hattoriana* MEISTER, Beiträge zur Bacillar. Japan 2 (1914) 226–227, pl. 8, figs. 1–3.

Valve linear with rostrate ends. Length, 0.061 mm; breadth, 0.005. Striæ 12 in 0.01 mm. Not common in Kizaki Lake. Reported from Yokohama.

CERATONEIS ARCUS Kütz. var. **AMPHIOXYS** (Rabh.). Plate 2, fig. 36; Plate 9, figs. 13 and 16.

Ceratoneis arcus Kutz. var. *amphioxys* (Rabh.), FR. HUSTEDT, Bacillar. (1930) 135, fig. 123.

Valve lanceolate with asymmetrical sides. Length, 0.017 to 0.032 mm; breadth, 0.0045 to 0.006. Striæ 15 to 18 in 0.01 mm. Common in Kizaki Lake.

FRAGILARIA HARRISSONII W. Smith. Plate 16, fig. 5.

Fragilaria Harrissonii W. Smith, FR. HUSTEDT, Bacillar. (1930) 139–140, fig. 132.

Valve broad, cross-shaped with rounded ends. Length, 0.014 mm; breadth, 0.008. Pseudoraphe narrow. Costæ very distinct. A fresh-water diatom.

FRAGILARIA HARRISSONII W. Smith var. RHOMBOIDES Grun. Plate 14, fig. 8.

Fragilaria Harrissonii W. Smith var. *rhomboides* Grun., FR. HUSTEDT, Bacillar. (1930) 140, fig. 133.

Valve broad-lanceolate. Length, 0.01 mm, breadth, 0.005. Costæ robust, 9 in 0.01 mm.

FRAGILARIA HARRISSONII W. Smith var. DUBIA Grun. Plate 16, fig. 6.

Fragilaria Harrissonii W. Smith var. *dubia* Grun., FR. HUSTEDT, Bacillar. (1930) 140, fig. 134.

Valve lanceolate with attenuate and capitate ends. Length, 0.0187 mm; breadth, 0.005. Costæ robust, 9 in 0.01 mm. Not common. Known in European lakes.

FRAGILARIA PINNATA Ehr. Plate 1, fig. 9; Plate 12, fig. 21.

Fragilaria pinnata Ehr., FR. HUSTEDT, Bacillar. (1930) 142, fig. 141b.

Valve elliptical, with broad ends. Length, 0.0034 to 0.006 mm; breadth, 0.0027 to 0.0034. Costæ 12 in 0.01 mm. A fresh-water diatom. In Kizaki Lake variety *lancettula* is reported.

FRAGILARIA CROTONENSIS Kitton. Plate 1, fig. 26.

Fragilaria crotonensis Kitton, FR. HUSTEDT, Bacillar. (1930) 137–138, fig. 125.

Valve linear-lanceolate with long-acuminate ends. Length, 0.12 to 0.015 mm; breadth, 0.003. Striæ 12 to 13 in 0.01 mm. Common in fresh water. Known from Aokiko Lake.

FRAGILARIA GRACILLIMA Mayer. Plate 1, fig. 23.

Fragilaria gracillima Mayer, FR. HUSTEDT, Bacillar. (1930) 139, fig. 131.

Valve long-lanceolate with capitate and constricted ends. Pseudoraphe very narrow, indistinct. Length, 0.018 mm; breadth, 0.002. Striæ very fine, 24 in 0.01 mm. This species is reported from Germany only.

FRAGILARIA CAPUCINA Desm. Plate 1, fig. 21.

Fragilaria capucina Desm., FR. HUSTEDT, Bacillar. (1930) 138, fig. 126.

Valve sublinear with slightly rostrate and obtuse ends. Length, 0.04 mm; breadth, 0.004. Striæ 12 in 0.01 mm. Pseudoraphe very narrow. In the middle part of the valve the striæ are interrupted, forming a quadrate central area. A plankton species, known also from Aokiko Lake in Nippon.

FRAGILARIA VIRESCENS Ralfs. Plate 9, fig. 15.

Fragilaria virescens Ralfs, FR. HUSTEDT, Bacillar. (1930) 142, fig. 144.

Valve lanceolate, rostrate and obtuse. Length, 0.017 mm; breadth, 0.005. Striæ 18 in 0.01 mm. Pseudoraphe very

narrow and linear. Very common in Kizaki Lake. Known from many parts of the world.

FRAGILARIA VIRESCENS Ralfs var. ELLIPTICA Hustedt fo. NIPPONICA fo. nov. Plate 12, fig. 20.

Valve lanceolate, dilated, obtuse, not rostrate. Length, 0.009 mm; breadth, 0.003. Striæ 18 in 0.01 mm. This form differs from variety *elliptica* in having narrower valves.

FRAGILARIA BREVISTRIATA Grun. Plate 14, fig. 9.

Fragilaria brevistriata Grun., FR. HUSTEDT, Bacillar. (1930) 145, fig. 151.

Valve lanceolate with acute ends. Length, 0.015 mm; breadth, 0.0034. Striæ 18 in 0.01 mm, marginal. Common.

FRAGILARIA BREVISTRIATA Grun. var. INFLATA (Pant.) Hustedt fo. CURTA fo. nov. Plate 1, fig. 18.

Valve short, lanceolate, with attenuate, obtuse ends. Length, 0.0085 mm; breadth, 0.0034. Striæ 15 in 0.01 mm. The typical variety *inflata* has a more elongate valve.

FRAGILARIA BREVISTRIATA Grun. var. NIPPONICA var. nov. Plate 16, fig. 7.

Valve lanceolate, biconstricted, with rostrate ends. Length, 0.02 mm; breadth, 0.005. Striæ 15 to 17 in 0.01 mm. This diatom resembles, under a low power, *Fragilaria Magocsyi* Lacsny known from Hungary, from which, however, it is different.

FRAGILARIA CONSTRUENS (Ehr.) Grun. Plate 1, figs. 28 and 29.

Fragilaria construens (Ehr.) Grun., A. SCHMIDT, Atlas Diatom. pl. 296, figs. 40–47.

Valve broad-lanceolate with rostrate ends. Length, 0.008 to 0.01 mm; breadth, 0.004 to 0.006. Striæ 15 to 18 in 0.01 mm. This diatom is widely distributed in fresh waters.

FRAGILARIA CONSTRUENS (Ehr.) Grun. var. SUBSALINA Hustedt. Plate 11, fig. 19.

Fragilaria construens (Ehr.) Grun. var. *subsalina* HUSTEDT, Bacillar. (1930) 141, fig. 139.

Valve linear-lanceolate with obtuse ends. Length, 0.012 mm; breadth, 0.0032. Striæ 15 in 0.01 mm. This variety differs from the type in its narrower valves. It is known from brackish waters of Europe.

FRAGILARIA CONSTRUENS (Ehr.) Grun. var. TRIUNDULATA Reichelt. Plate 10, fig. 32.

Fragilaria construens (Ehr.) Grun. var. *triundulata* Reichelt, FR. HUSTEDT, Bacillar. (1930) 140, fig. 136.

Valve lanceolate, triundulate with rostrate ends. Length, 0.02 mm; breadth, 0.005. Striæ 18 in 0.01 mm. Pseudoraphe linear. Not common in Kizaki Lake.

FRAGILARIA CONSTRUENS (Ehr.) Grun. var. BINODIS (Ehr.) Grun. Plate 1, fig. 17; Plate 16, fig. 9.

Fragilaria construens (Ehr.) Grun. var. *binodis* (Ehr.) Grun., FR. HUSTEDT, Bacillar. (1930) 140–141, fig. 137.

Valve biconstricted. Length, 0.017 to 0.02 mm; breadth, 0.005 to 0.006. Striæ 15 in 0.01 mm. Variety *binodis* is reported from Aokiko Lake.

FRAGILARIA CONSTRUENS (Ehr.) Grun. var. NIPPONICA var. nov. Plate 10, fig. 15; Plate 16, fig. 13.

Valve minute, broad-lanceolate with rostrate ends; constricted from one or from both sides. Length, 0.009 to 0.011 mm; breadth, 0.005. Striæ 15 in 0.01 mm. This differs from variety *binodis* in its shorter valves.

ASTERIONELLA GRACILLIMA (Hantzsch) Heiberg. Plate 1, figs. 33 and 34.

Asterionella gracillima (Hantzsch) Heiberg, FR. HUSTEDT, Bacillar. (1930) 147, fig. 157.

Valve linear with capitate ends. Length, 0.072 to 0.08 mm; breadth, 0.002. Abundant in Kizaki Lake.

SYNEDRA NANA Meister var. NIPPONICA var. nov. Plate 10, fig. 29.

Valve sublinear, attenuate towards the ends. Length, 0.026 to 0.049 mm; breadth, 0.0017 to 0.002. Striæ marginal, very fine, about 30 to 35 in 0.01 mm. Differs from the type in its slightly convex margins.

SYNEDRA ULNA (Nitzsch) Ehr. Plate 1, fig. 36; Plate 3, fig. 8.

Synedra Ulna (Nitzsch) Ehr., FR. HUSTEDT, Bacillar. (1930) 151, fig. 159.

Valve linear-lanceolate with broad ends. Length, 0.136 to 0.221 mm; breadth, 0.006 to 0.008. Striæ 9 to 10 in 0.01 mm. Common in fresh water.

SYNEDRA ULNA (Nitzsch) Ehr. var. RAMESI (Herib. and Perag.) Hustedt. Plate 1, fig. 37.

Synedra Ulna (Nitzsch) Ehr. var. *Ramesi* (Herib. and Perag.) Hustedt, FR. HUSTEDT, Bacillar. (1930) 152, fig. 163.

Valve linear-lanceolate, little constricted and with truncate ends. Length, 0.054 mm; breadth, 0.006. Striæ 11 to 12 in 0.01 mm. Uncommon.

SYNEDRA ULNA (Nitzsch) Ehr. var. BICEPS (Kütz.) Plate 1, fig. 39.

Synedra Ulna (Nitzsch) Ehr. var. *biceps* (Kütz.), FR. HUSTEDT, Bacillar. (1930) 154, fig. 166.

Valve long, linear with capitate ends. Length, 0.2 to 0.25 mm; breadth, 0.0045. Striæ 8.5 in 0.01 mm. Common in Kizaki Lake.

SYNEDRA ULNA (Nitzsch) Ehr. var. DANICA (Kütz.) Grun. Plate 10, fig. 10.

Synedra Ulna (Nitzsch) Ehr. var. *danica* (Kütz.) Grun., FR. HUSTEDT, Bacillar. (1930) 154, fig. 168.

Valve lanceolate, attenuated towards the ends. Ends slightly subtruncate and constricted. Length, 0.17 mm; breadth, 0.005. Striæ 9 in 0.01 mm.

SYNEDRA GOULARDI (Breb.) Grun. Plate 10, fig. 22.

Synedra Goulardi (Breb.) Grun., A. SCHMIDT, Atlas Diatom. pl. 300, figs. 10–18.

Valve deeply constricted with truncate-rostrate ends. Length, 0.039 mm; breadth, 0.0065. Striæ 15 in 0.01 mm. Known from Demerara River, Paraguay, and from Victoria Lake, Africa.

SYNEDRA RUMPENS Kütz. var. MENEGHINIANA Grun. Plate 3, fig. 22.

Synedra rumpens Kütz. var. *Meneghiniana* Grun., FR. HUSTEDT, Bacillar. (1930) 156, fig. 178.

Valve lanceolate with truncate ends. Length, 0.03 mm; breadth, 0.035. Striæ 12 in 0.01 mm. Not common.

SYNEDRA RUMPENS Kütz. var. NIPPONICA var. nov. Plate 1, fig. 20.

Valve sublinear, narrowly attenuated towards the ends. Striæ very fine, 30 in 0.01 mm, interrupted in the middle part, forming a rectangular area. Length, 0.03 mm; breadth, 0.003. Differs from the type in its fine striæ.

SYNEDRA CYCLOPUM Brutschi var. NIPPONICA var. nov. Plate 13, fig. 37.

Valve linear-lanceolate, sigmoid, attenuate towards the ends. Length, 0.018 mm; breadth, 0.002. Striæ 18 in 0.01 mm. The typical forms of *Synedra cyclopum* have the valves larger and they are curved to one side. *Synedra cyclopum* is reported from Europe.

SYNEDRA JAPONICA Meister. Plate 1, fig. 27; Plate 10, fig. 9.

Synedra japonica MEISTER, Beiträge zur Bacillar. Japans (1913) 307, figs. 5–6.

Valve linear-lanceolate with long capitate horns. Length, 0.144 to 0.187 mm; breadth, 0.0028 to 0.003. Striæ 11 to 13 in 0.01 mm, interrupted in the middle and forming a quadrate area. Pseudoraphe very narrow. Common in Kizaki Lake. Known from Suwa Lake, Nippon.

SYNEDRA VAUCHERIÆ Kütz. Plate 1, fig. 14.

Synedra Vaucheriæ Kütz., FR. HUSTEDT, Bacillar. (1930) 161, fig. 192.

Valve lanceolate, broad and obtuse. Length, 0.012 mm; breadth, 0.0025. Striæ 16 in 0.01 mm. Common in Kizaki Lake.

SYNEDRA VAUCHERIÆ Kütz. var. **CAPITELLATA** Grun. Plate 1, fig. 15; Plate 2, fig. 28.

Synedra Vaucheriæ Kütz. var. *capitellata* Grun., FR. HUSTEDT, Bacillar. (1930) 161, fig. 194.

Valve lanceolate, attenuate towards the ends. Ends capitate. Length, 0.018 to 0.023 mm; breadth, 0.0028 to 0.0042. Striæ 12 to 16 in 0.01 mm.

SYNEDRA VAUCHERIÆ Kütz. var. **SIGMOIDEA** var. nov. Plate 1, fig. 42.

Valve lanceolate, sigmoid, with capitate ends, turned opposite. Length, 0.02 mm; breadth, 0.004. Striæ fine, 18 in 0.01 mm. Not common in Kizaki Lake.

SYNEDRA PARASITICA (W. Smith). Plate 1, fig. 22.

Fragilaria parasitica W. Smith, A. SCHMIDT, Atlas Diatom. pl. 296, figs. 76–80.

Valve lanceolate, convex, with produced ends. Pseudoraphe wide. Length, 0.012 to 0.02 mm; breadth, 0.004 to 0.005. Striæ 18 in 0.01 mm. Meister described *Fragilaria parasitica* var. *asterionellodes* from Nippon, a variety forming asterionelloid colonies.

SYNEDRA NIPPONICA sp. nov. Plate 1, fig. 43.

Valve minute, lanceolate, attenuate towards the ends. Pseudoraphe very narrow. Length, 0.01 mm; breadth, 0.002. Striæ 18 in 0.01 mm. A species related to *Synedra parasitica.*

ACTINELLA BRASILIENSIS Grun. Plate 8, fig. 11.

Actinella brasiliensis Grun., A. SCHMIDT, Atlas Diatom. pl. 292, figs. 10–19.

Valve linear, inflated at one end, capitate and apiculate. Length, 0.088 mm; breadth, 0.013. Striæ 10 in 0.01 mm. Not common in Kizaki Lake. Reported from Brazil, Chosen, and Hanka Lake in Siberia, and as a fossil in southern Europe.

EUNOTIA SEPTENTRIONALIS Oestrup. Plate 12, fig. 23.

Eunotia septentrionalis Oestrup, FR. HUSTEDT, Bacillar. (1930) 179, fig. 232.

Valve lanceolate with gibbous dorsal and parallel ventral sides. Length, 0.0136 mm; breadth, 0.0034. Striæ 18 in 0.01 mm. Not common in Kizaki Lake. Reported from Germany as a relict.

EUNOTIA TROPICA Hustedt. Plate 8, figs. 10 and 16.

Eunotia tropica HUSTEDT, Bacillar a. d. Aokikosee in Japan 159, pl. 5, fig. 1.

Valve robust with four or five undulations on the dorsal side. Length, 0.078 to 0.088 mm; breadth, 0.017. Striæ 8 to 9 in 0.01 mm. Uncommon in Kizaki Lake. Known from Aokiko Lake, from Foochow, southern China, and, according to Fr. Hustedt, from the Tropics.

EUNOTIA FABA (Ehr.) Grun. var. **NIPPONICA** var. nov. Plate 14, fig. 4.

Valve linear and obtuse. Length, 0.013 to 0.016 mm; breadth, 0.0028 to 0.003. Striæ fine, 18 in 0.01 mm. Typical *Eunotia faba* has larger valves, and is an alpine plant.

EUNOTIA PALUDOSA Grun. Plate 1, fig. 25.

Eunotia paludosa Grun., FR. HUSTEDT, Bacillar. (1930) 178, fig. 228.

Valve linear, curved, with rostrate-truncate ends. Length, 0.047 mm; breadth, 0.005. Striæ 12 in 0.01 mm. Reported from Europe.

EUNOTIA LUNARIS (Ehr.) Grun. Plate 1, fig. 44.

Eunotia lunaris (Ehr.) Grun., FR. HUSTEDT, Bacillar. (1930) 183, fig. 249.

Valve linear, curved. Length, 0.085 mm; breadth, 0.0025. Striæ 18 in 0.01 mm. Uncommon in Kizaki Lake.

EUNOTIA GRACILIS (Ehr.) Rabh. Plate 1, fig. 40.

Eunotia gracilis (Ehr.) Rabh., FR. HUSTEDT, Bacillar. (1930) 185, fig. 253.

Valve long, curved, with capitate ends. Length, 0.111 mm; breadth, 0.005. Striæ 12 in 0.01 mm. Occasional in Kizaki Lake.

EUNOTIA VALIDA Hustedt. Plate 1, fig. 41.

Eunotia valida HUSTEDT, Bacillar. (1930) 178, fig. 229.

Valve linear, robust, with obtuse ends. Length, 0.096 mm; breadth, 0.0042. Striæ 12 in 0.01 mm. Reported from wet rocks from Europe.

EUNOTIA VENERIS (Kütz.) O. Mull. var. NIPPONICA var. nov. Plate 1, fig. 31.

Valve lanceolate-attenuate towards the ends. Length, 0.0187 mm; breadth, 0.0034. Striæ 15 in 0.01 mm. Differs from the type in having broader ends.

EUNOTIA PRÆRUPTA Ehr. Plate 12, fig. 25.

Eunotia praerupta Ehr., FR. HUSTEDT, Bacillar. (1930) 174, fig. 211.

Valve robust, curved, with convex dorsal sides. Length, 0.051 mm; breadth, 0.01. Striæ 12 to 15 in 0.01 mm. An alpine diatom.

EUNOTIA PECTINALIS (Kütz.) Rabh. var. MINOR (Kütz.) Rahb. Plate 1, fig. 30.

Eunotia pectinalis (Kütz.) Rabh. var. *minor* (Kütz.) Rabh., FR. HUSTEDT, Bacillar. (1930) 182, fig. 238.

Valve linear, curvate, slightly attenuate and obtuse. Length, 0.03 mm; breadth, 0.006. Striæ 10 to 11 in 0.01 mm. Common in fresh water.

EUNOTIA PECTINALIS (Kütz.) Rabh. var. MINOR (Kütz.) Rabh. fo. IMPRESSA (Ehr.). Plate 14, fig. 10.

Eunotia pectinalis (Kütz.) Rabh. var. *minor* (Kütz.) Rabh. fo. *impressa* (Ehr.), FR. HUSTEDT, Bacillar. (1930) 182, fig. 239.

Valve lanceolate, curvate, constricted on the dorsal side. Length, 0.022 mm; breadth, 0.004. Striæ 15 in 0.01 mm. Common in marsh water.

EUNOTIA PECTINALIS (Kütz.) Rabh. var. NIPPONICA var. nov. Plate 1, fig. 32.

Valve lanceolate, attenuate towards the ends, obtuse. Two interruptions in the middle of the ventral side. Length, 0.019 mm; breadth, 0.0048. Striæ 15 in 0.01 mm. Differs from the type by its interruptions.

COCCONEIS PLACENTULA (Ehr.) var. LINEATA (Ehr.) Cleve. Plate 2, fig. 5.

Cocconeis placentula (Ehr.) var. *lineata* (Ehr.) Cleve, FR. HUSTEDT, Bacillar. (1930) 190, fig. 262.

Valve elliptical with broad ends. Length, 0.022 mm; breadth, 0.012. Striæ 18 to 20 in 0.01 mm. Common in fresh water.

COCCONEIS PLACENTULA (Ehr.) var. **KLINORAPHIS** Geitler fo. **NIPPONICA** fo. nov. Plate 2, fig. 8.

Valve elliptical with a curvate median line. Length, 0.039 mm; breadth, 0.018. Striæ 24 in 0.01 mm. Differs from variety *klinoraphis* in its broad rounded ends.

COCCONEIS DIMINUTA Pant.? Plate 2, figs. 16 to 18.

Cocconeis diminuta Pant.?, FR. HUSTEDT, Bacillar. (1930) 190, fig. 265.

Valve broadly elliptical. Length, 0.008 to 0.018 mm; breadth, 0.005 to 0.01. Upper valve with linear axial area. Striæ 22 in 0.01 mm. Lower valve with lanceolate axial area with coarse elongate puncta, 12 in 0.01 mm. Common. Known from Nippon.

EUCOCCONEIS FLEXELLA (Kütz.) Plate 2, fig. 39.

Eucocconeis flexella (Kütz.), FR. HUSTEDT, Bacillar. (1930) 193, fig. 270.

Valve elliptical with an arcuate median line. Length, 0.035 mm; breadth, 0.015. Common in alpine waters.

ACHNANTHES MICROCEPHALA Kütz. Plate 2, fig. 22.

Achnanthes microcephala (Kütz.) FR. HUSTEDT, Bacillar. (1930) 198, fig. 273.

Valve linear with subcapitate ends. Length, 0.018 mm; breadth, 0.0025. Striæ indistinct. Known from fresh water in Europe.

ACHNANTHES KIZAKI sp. nov. Plate 2, fig. 25.

Valve linear, enlarged in the middle, with broad, capitate ends. Length, 0.013 mm; breadth, 0.002. Upper valve with a narrow, linear axial area and a narrow, rectangular, central area. Lower valve with slightly dilated central area. Striæ very fine, about 40 in 0.01 mm. A species related to *A. microcephala* Kütz.

ACHNANTHES HAUCKIANA Grun. Plate 12, fig. 26.

Achnanthes Hauckiana Grun., FR. HUSTEDT, Bacillar. (1930) 202, fig. 290.

Valve elliptical, obtuse. Length, 0.015 mm; breadth, 0.005. Upper valve with a linear axial area. Striæ 14 in 0.01 mm. Lower valve with a broad central area. Striæ radiate. Known from hot springs and brackish water.

ACHNANTHES HAUCKIANA Grun. var. ELLIPTICA Schulz. fo. NIPPONICA fo. nov. Plate 14, fig. 6.

Valve elliptical. Length, 0.01 mm; breadth, 0.042. Upper valve with linear axial area. Striæ 18 in 0.01 mm, radiate. Lower valve with a broad central area. Differs from variety *elliptica* in its coarser striæ.

ACHNANTHES OESTRUPII (A. Cleve) Hustedt. Plate 2, figs. 31 and 32; Plate 12, fig. 17.

Achnanthes Oestrupii (A. Cleve) Hustedt, Bacillar. (1930) 257, fig. 301.

Valve broad-elliptical. Length, 0.09 to 0.015 mm; breadth, 0.007 to 0.0085. Upper valve with a linear axial area, on one side of which in the middle of the valve there is a horseshoe-shaped area. Striæ robust, radiate, 12 to 18 in 0.01 mm. Lower valve with a narrow stauros. Striæ very fine, about 35 in 0.01 mm. Known from Europe.

ACHNANTHES CLEVEI Grun. var. NIPPONICA var. nov. Plate 2, fig. 24.

Valve lanceolate, convex, acute, obtuse. Length, 0.014 mm; breadth, 0.005. Upper valve with narrow, linear, axial area. Striæ distinctly punctate, 12 in 0.01 mm, radiate. Puncta 15 in 0.01 mm. Lower valve with narrow central area. Striæ very fine, 20 to 22 in 0.01 mm. Differs from the type in its obtuse ends and differs from variety *rostrata* Hustedt in its broad end. *Achnanthes Clevei* is known from Europe.

ACHNANTHES EXIGUA Grun. Plate 7, fig. 16.

Achnanthes exigua Grun., FR. HUSTEDT, Bacillar. (1930) 201–202, fig. 286.

Valve elliptic with rostrate ends. Length, 0.015 mm; breadth, 0.006. Striæ 24 in 0.01 mm. Known from fresh water and hot springs. Reported from Aokiko Lake.

ACHNANTHES EXIGUA Grun. var. INDICA Skvortzow. Plate 2, fig. 38.

Achnanthes exigua Grun. var. *indica* SKVORTZOW, Diatoms from Calcutta (1935) pl. 1, fig. 3.

Valve minute, broad-ovate. Length, 0.0068 mm; breadth, 0.0042. Upper valve with narrow axial area. Striæ parallel, 18 to 20 in 0.01 mm. Lower valve with narrow axial area, and with central area forming a short stauros with one median shortened stria opposite the stauros. Recently described by me from Calcutta, India.

ACHNANTHES EXIGUA Grun. var. NIPPONICA var. nov. Plate 7, figs. 7 and 8.

Valve elliptical with rostrate ends. Length, 0.012 mm; breadth, 0.0062. Upper valve with a narrow axial area. Striæ

18 in 0.01 mm, parallel, at the ends slightly radiate. Lower valve with a median stria, opposite to the fascia being shortened. The type of *Achnanthes exigua* Grun. differs from variety *nipponica* in its bilateral broad fascia.

ACHNANTHES PERAGALLII Brun and Heribaud. Plate 2, fig. 30.

Achnanthes Peragalli BRUN and HERIBAUD, Diatom. d'Auvergne (1893) 50, pl. 1, fig. 4.

Valve broadly elliptical with apiculate ends. Length, 0.012 mm; breadth, 0.006. Upper valve with lanceolate axial area, on one side of which there is a horseshoe area. Striæ 18 in 0.01 mm. Lower valve with dilated central area. Known from Aokiko Lake.

ACHNANTHES PERAGALLII Brun and Heiribaud var. NIPPONICA var. nov. Plate 2, fig. 10.

Valve lanceolate, convex, with long-attenuate ends. Length, 0.025 mm; breadth, 0.0085. Upper valve with a broad, axial area. Central area of the lower valve with a broad stauros. Differs from the type in its more elongate shape. Common in Kizaki Lake.

ACHNANTHES GRACILLIMA Hustedt var. NIPPONICA var. nov. Plate 4, figs. 3 and 4; Plate 6, fig. 9.

Valve slightly siliceous, narrow-lanceolate with attenuate and capitate ends. Length, 0.015 to 0.018 mm; breadth, 0.0034 to 0.0036. Upper valve with indistinct axial area. Lower valve with a narrow axial area outwardly dilated. Striæ very fine, indistinct. Common in Kizaki Lake. The type is reported from Aokiko Lake.

ACHNANTHES AFFINIS Grun. var. MINUTA var. nov. Plate 10, fig. 27.

Valve linear-lanceolate with obtuse ends. Length, 0.0085 mm; breadth, 0.0017. Upper valve with a narrow axial area. Striæ radiate, very fine, in the middle 30, at the ends 40, in 0.01 mm. Lower valve with a dilated central area. The type of *Achnanthes affinis* occurs in fresh waters of Europe, Tasmania, and North America.

ACHNANTHES MINUTISSIMA Kütz. Plate 2, figs. 15 and 23.

Achnanthes minutissima Kütz., FR. HUSTEDT, Bacillar. (1930) 198, fig. 274.

Valve linear with attenuate and obtuse ends. Length, 0.013 to 0.022 mm; breadth, 0.002 to 0.005. Striæ 28 in 0.01 mm or very fine and indistinct. Not common.

ACHNANTHES MINUTISSIMA Kütz. var. **CRYPTOCEPHALA** Grun. Plate 2, fig. 21.

Achnanthes minutissima Kütz. var. *cryptocephala* Grun., FR. HUSTEDT, Bacillar. (1930) 198, fig. 275.

Valve linear with capitate ends. Length, 0.015 mm; breadth, 0.002. Striæ 30 in 0.01 mm. Uncommon.

ACHNANTHES LINEARIS W. Smith var. **PUSILLA** Grun. Plate 10, fig. 17.

Achnanthes linearis W. Smith var. *pusilla* Grun., FR. HUSTEDT, Bacillar. (1930) 198, fig. 277.

Valve elongate-linear with obtuse ends. Length, 0.012 mm; breadth, 0.002. Striæ widened in the middle part of the valve, 24 in 0.01 mm. Known from Greenland and Norway.

ACHNANTHES LANCEOLATA Breb. Plate 2, figs. 11 and 12.

Achnanthes lanceolata Breb., FR. HUSTEDT, Bacillar. (1930) 207, fig. 306a.

Valve elliptic-lanceolate, ends obtuse. Length, 0.0136 mm; breadth, 0.005. Upper valve with lanceolate axial area and with a horseshoe area on one of the sides. Lower valve with a quadrate or rectangular central area. Striæ 15 in 0.01 mm. Common in fresh water. Known from Aokiko Lake.

ACHNANTHES LANCEOLATA Breb. var. **ELLIPTICA** Cleve. Plate 2, fig. 29.

Achnanthes lanceolata Breb. var. *elliptica* Cleve, FR. HUSTEDT, Bacillar. (1930) 208, fig. 306c.

Valve elliptic, obtuse. Length, 0.015 mm; breadth, 0.0085. Striæ 18 in 0.01 mm. An alpine species, reported from Europe.

ACHNANTHES LANCEOLATA Breb. var. **ROSTRATA** Hustedt. Plate 2, fig. 20; Plate 8, fig. 8; Plate 10, fig. 18.

Achnanthes lanceolata Breb. var. *rostrata* HUSTEDT, Bacillar. (1930) 207–208, fig. 306b.

Valve elliptical with rostrate ends. Length, 0.012 to 0.018 mm; breadth, 0.005 to 0.0068. Upper valve with a lanceolate axial area and on one side with a horseshoe area. Striæ robust, 12 to 18 in 0.01 mm.

ACHNANTHES LANCEOLATA Breb. var. **NIPPONICA** var. nov. Plate 12, fig. 13.

Valve broad-lanceolate, slightly gibbous in the middle, narrowed towards the ends. Length, 0.015 mm; breadth, 0.006. Upper valve with a lanceolate axial area and with a horseshoe area on one side. Lower valve with a rectangular central area. Striæ 12 in 0.01 mm. Not common.

ACHNANTHES PINNATA Hustedt var. **JAPONICA** Hustedt. Plate 2, fig. 19; Plate 4, fig. 26.

Achnanthes pinnata Hustedt var. *japonica* HUSTEDT, Bacillar. a. d. Aokikosee in Japan 161, pl. 5, figs. 12–15.

Valve minute, elliptic and obtuse. Length, 0.0051 to 0.006 mm; breadth, 0.0034. Upper valve with very narrow axial area. Striæ 18 in 0.01 mm. Lower valve with indistinct axial area and with a small central area. Reported only from Aokiko Lake, Nippon.

RHOICOSPHENIA CURVATA (Kütz.) Grun.

Rhoicosphenia curvata (Kütz.) Grun., FR. HUSTEDT, Bacillar. (1930) 211, fig. 311.

Valve clavate. Length, 0.049 mm; breadth, 0.0025. Common in fresh and brackish water.

AMPHIPLEURA PELLUCIDA Kütz. Plate 3, fig. 3.

Amphipleura pellucida Kütz., FR. HUSTEDT, Bacillar. (1930) 218, fig. 321.

Valve lanceolate-attenuate. Length, 0.085 mm; breadth, 0.007. Striæ very fine. Found in fresh and slightly brackish water. Known from Nippon.

AMPHIPLEURA PELLUCIDA Kütz. var. RECTA Kitton. Plate 3, fig. 6.

Amphipleura pellucida Kütz. var. *recta* KITTON, Journ. Quekett Micr. Soc. 2: 21, pl. 4, fig. 4.

Valve linear with gently cuneate ends. Length, 0.2 mm; breadth, 0.013. Striæ 30 in 0.01 mm. According to Kitton variety *recta* is a marine diatom found in Nippon. Reported by me from a mountain stream in southern China (Foochow, Fukien Province).

FRUSTULIA VULGARIS Thwaites. Plate 4, fig. 11.

Frustulia vulgaris Thwaites, FR. HUSTEDT, Bacillar. (1930) 221, fig. 327.

Valve linear and obtuse. Length, 0.044 mm; breadth, 0.0085. Striæ very fine. Not common. Reported from Nippon.

FRUSTULIA RHOMBOIDES (Ehr.) de Toni. Plate 4, fig. 19.

Frustulia rhomboides (Ehr.) de Toni, FR. HUSTEDT, Bacillar. (1930) 220, fig. 324.

Valve rhombic-lanceolate, attenuate with obtuse ends. Length, 0.17 mm; breadth, 0.03. Central nodule small or elongate. Striæ 24 in 0.01 mm. Common in fresh water.

FRUSTULIA RHOMBOIDES (Ehr.) de Toni var. AMPHIPLEUROIDES Grun. Plate 4, fig. 18.

Frustulia rhomboides (Ehr.) de Toni var. *amphipleuroides* Grun., FR. HUSTEDT, Bacillar. (1930) 221, fig. 326.

Valve lanceolate, obtuse. Length, 0.127 mm; breadth, 0.018. Striæ 24 in 0.01 mm. Reported from Aokiko Lake, Nippon.

FRUSTULIA RHOMBOIDES (Ehr.) de Toni var. SAXONICA (Rabh.) de Toni fo. CAPITATA A. Mayer. Plate 4, fig. 12.

Frustulia rhomboides (Ehr.) de Toni var. *saxonica* (Rabh.) de Toni fo. *capitata* A. Mayer, FR. HUSTEDT, Bacillar. (1930) 221.

Valve lanceolate with capitate ends. Length, 0.044 mm; breadth, 0.013. Uncommon.

FRUSTULIA RHOMBOIDES (Ehr.) de Toni var. SAXONICA (Rabh.) de Toni fo. UNDULATA Hustedt.

Frustulia rhomboides (Ehr.) de Toni var. *saxonica* (Rabh.) de Toni fo. *undulata* HUSTEDT, Bacillar. (1930) 221.

Valve slightly triundulate with capitate ends. Length, 0.056 mm; breadth, 0.012. Rare in Kizaki Lake.

GYROSIGMA ACUMINATUM (Kütz.) Rabh. Plate 9, fig. 14.

Gyrosigma acuminatum (Kütz.) Rabh., FR. HUSTEDT, Bacillar. (1930) 222–223, fig. 309.

Valve with longitudinal and transverse striæ, 18 in 0.01 mm. Length, 0.136 mm; breadth, 0.02. Common.

GYROSIGMA KUTZINGII (Grun.) Cleve. Plate 3, fig. 7.

Gyrosigma Kützingii (Grun.) Cleve, FR. HUSTEDT, Bacillar. (1930) 224, fig. 333.

Valve sigmoid and attenuate. Length, 0.098 mm; breadth, 0.012. Striæ, transversal 18, longitudinal 30, in 0.01 mm. A fresh-water species. Known from Nippon.

GYROSIGMA SCALPROIDES (Rabh.) Cleve. Plate 12, fig. 5.

Gyrosigma scalproides (Rabh.) Cleve, FR. HUSTEDT, Bacillar. (1930) 226, fig. 338.

Valve sigmoid with broad ends. Striæ, longitudinal 30, transversal 24, in 0.01 mm. Length, 0.064 mm; breadth, 0.008. Known from Europe, America, and Africa.

CALONEIS SILICULA (Ehr.) Cleve var. TUMIDA Hustedt fo. NIPPONICA fo. nov. Plate 9, fig. 3.

Valve triundulate with broad ends. Length, 0.102 mm; breadth, 0.015. Striæ radiate, 18 in 0.01 mm. Differs from the type in its broad and long ends.

CALONEIS SILICULA (Ehr.) Cleve var. TRUNCATULA Grun. Plate 4, fig. 17.

Caloneis silicula (Ehr.) Cleve var. *truncatula* Grun., FR. HUSTEDT, Bacillar. (1930) 238, fig. 363.

Valve slightly undulate in the middle part. Central area a broad fascia. Length, 0.022 mm; breadth, 0.0058. Striæ 24 in 0.01 mm. Common in fresh water.

CALONEIS SILICULA (Ehr.) Cleve var. BAICALENSIS Skvortzow and Meyer. Plate 3, fig. 9.

Caloneis silicula (Ehr.) Cleve var. *baicalensis* SKVORTZOW and MEYER, Contribut. diatoms of Baikal Lake (1928) 12, pl. 1, fig. 44.

Valve linear, triundulate with broad capitate ends. Striæ 24 in 0.01 mm. Central area with a broad stauros. Length, 0.061 mm; breadth, 0.011. Reported from Baikal Lake, Siberia.

NEIDIUM HITCHCOCKII Ehr. Plate 4, fig. 1.

Neidium Hitchcockii Ehr., A. SCHMIDT, Atlas Diatom. pl. 49, figs. 35–36.

Valve elliptic, triundulate with rostrate ends. Length, 0.057 mm; breadth, 0.013. Striæ 18 in 0.01 mm. Common in fresh water.

NEIDIUM PRODUCTUM (W. Smith) Cleve fo. CONSTRICTA Hustedt. Plate 4, fig. 2.

Neidium productum (W. Smith) Cleve fo. *constricta* HUSTEDT, Bacillar. (1930) 246.

Valve constricted with apiculate ends. Length, 0.049 mm; breadth, 0.011. Striæ 24 in 0.01 mm.

NEIDIUM AFFINE (Ehr.) Cleve fo. HERCYNICA (A. Mayer) Hust. Plate 4, fig. 6.

Neidium affine (Ehr.) Cleve fo. *hercynica* (A. Mayer) HUSTEDT, Bacillar. (1930) 243.

Neidium affine var. *genuina* CLEVE, Bacillar. d. Regensburger Gewässer (1913) 109, pl. 10, fig. 33.

Valve lanceolate with obtuse ends. Length, 0.037 mm; breadth, 0.01. Striæ 20 to 24 in 0.01 mm. Known from Europe.

NEIDIUM BISULCATUM (Lagerst.) Cleve var. NIPPONICA var. nov. Plate 3, fig. 1; Plate 4, fig. 8.

Valve linear-lanceolate with slightly attenuate ends. Length, 0.034 to 0.06 mm; breadth, 0.006 to 0.01. Striæ 20 to 30 in 0.01 mm. Differs from the type in its attenuate and acute ends. The type is common in alpine regions.

NEIDIUM DUBIUM (Ehr.) Cleve. Plate 12, fig. 10.

Neidium dubium (Ehr.) Cleve, FR. HUSTEDT, Bacillar. (1930) 246, fig. 385.

Valve broad-lanceolate with acuminate ends. Length, 0.034 mm; breadth, 0.01. Striæ 18 in 0.01 mm. Common in fresh and brackish waters.

NEIDIUM NIPPONICA sp. nov. Plate 8, fig. 1.

Valve large, lanceolate with obtuse ends. Striæ oblique, 18 in 0.01 mm, crossed by longitudinal marginal band. Axial area

narrow, widened on the middle part of each end. Central area broad. Length, 0.142 mm; breadth, 0.025. A distinct species; it resembles *Navicula* sp. figured in A. Schmidt, Atlas Diatom. pl. 49, fig. 1, from Monticello, New York.

NEIDIUM KOZLOWI Meresch. var. **NIPPONICA** var. nov. Plate 12, fig. 19.

Valve linear with parallel margins and rostrate ends. Striæ oblique, 24 to 28 in 0.01 mm. Axial area narrow. Central area broad. Length, 0.34 mm; breadth, 0.0062. Differs from variety *parva* Meresch. and variety *hankensis* Skv. in its rostrate ends and its size.

NEIDIUM OBLIQUE-STRIATUM A. S. var. **NIPPONICA** var. nov. Plate 4, figs. 5 and 22.

Valve lanceolate with attenuate ends. Striæ oblique, 16 to 17 in 0.01 mm. Length, 0.096 to 0.1 mm; breadth, 0.02 to 0.025. This new variety resembles *Neidium* sp. in A. Schmidt, Atlas Diatom. pl. 49, fig. 1, and *Neidium affine* var. *amphirhynchus* Ehr. fo. *maxima* Cleve, Navicul. Diatom. 69.

NEIDIUM OBLIQUE-STRIATUM A. S. var. **ROSTRATA** var. nov. Plate 4, fig. 16.

Valve with rostrate ends. Striæ oblique, 24 in 0.01 mm. Length, 0.061 mm; breadth, 0.015. Differs from the type in its rostrate ends.

NEIDIUM OBLIQUE-STRIATUM A. S. var. **APICULATA** var. nov. Plate 4, fig. 24.

Valve lanceolate with obtuse and apiculate ends. Length, 0.044 mm; breadth, 0.012. Striæ oblique, 14 in 0.01 mm. Not common.

DIPLONEIS OVALIS (Hilse) Cleve. Plate 2, fig. 37.

Diploneis ovalis (Hilse) Cleve, FR. HUSTEDT, Bacillar. (1930) 249, fig. 390.

Valve elliptic with broad and rounded ends. Length, 0.028 to 0.03 mm; breadth, 0.013 to 0.015. Central nodule large, rounded. Transverse rows of alveoli 9 to 10 in 0.01 mm, radiate at ends. Puncta 14 in 0.01 mm. Common in fresh water. Reported from Nippon. According to Fr. Hustedt, the Nippon forms of *Diploneis ovalis* are always large with double rows of alveoli. Such forms I find it desirable to separate.

DIPLONEIS OVALIS (Hilse) Cleve var. **OBLONGELLA** (Naegeli) Cleve. Plate 2, fig. 26.

Diploneis ovalis (Hilse) Cleve var. *oblongella* (Naegeli) Cleve, FR. HUSTEDT, Bacillar. (1930) 249, fig. 391.

Valve linear-elliptic. Length, 0.044 to 0.046 mm; breadth, 0.013 to 0.017. Rows of alveoli 10 to 11 in 0.01 mm. Very common in Kizaki Lake. Known from Aokiko Lake.

DIPLONEIS PUELLA (Schum.) Cleve. Plate 2, fig. 2.

Valve elliptic. Length, 0.023 mm; breadth, 0.012. Central nodule quadrate. Furrows narrow. Costæ 12 to 13 in 0.01 mm. Alveoli indistinct. Known from fresh and brackish waters.

DIPLONEIS MARGINESTRIATA Hustedt. Plate 12, fig. 9.

Diploneis marginestriata HUSTEDT, Bacillar. (1930) 250, fig. 393.

Valve elongate-elliptic with broad ends. Length, 0.032 mm; breadth, 0.01. Central nodule quadrate. Furrow broad, linear. Costæ 21 in 0.01 mm, radiate at the ends. Known from alpine lakes in Europe. Reported from Aokiko Lake, Nippon.

DIPLONEIS SMITHII (Breb.) Cleve var. **NIPPONICA** var. nov. Plate 2, figs. 1 and 9.

Valve elliptic. Length, 0.068 to 0.1 mm; breadth, 0.03 to 0.047. Central nodule quadrate. Terminal nodules distant from the ends. Furrows broad, inclosing a space one-fourth as broad as the valve. Costæ 5 to 6 in 0.01 mm, with double rows of alveoli, forming oblique lines. Differs from the type by its more elongate and attenuate ends. Very common in Kizaki Lake. The typical *Diploneis Smithii* is known as a brackish-water species.

DIPLONEIS SMITHII (Breb.) Cleve var. **OBLONGELLA** var. nov. Plate 9, fig. 1.

Valve elongate-elliptic with broad ends. Length, 0.098 to 0.1 mm; breadth, 0.035 to 0.039. Central nodule quadrate. Furrow broad-lanceolate, inclosing a space one-third as broad as the valve. Costæ 6 in 0.01 mm, with a double row of alveoli. Common in Kizaki Lake.

DIPLONEIS OCULATA (Breb.) Cleve. Plate 2, fig. 4.

Diploneis oculata (Breb.) Cleve, FR. HUSTEDT, Bacillar. (1930) 250, fig. 392.

Valve elongate-elliptic. Length, 0.024 mm; breadth, 0.0076. Central nodule quadrate. Furrows linear. Costæ 24 in 0.01 mm. Reported from Aokiko Lake.

DIPLONEIS OCULATA (Breb.) Cleve var. **NIPPONICA** var. nov. Plate 14, fig. 2.

Valve minute, elliptic with attenuated and rounded ends. Striæ fine, marginal, 18 in 0.01 mm. Length, 0.012 mm; breadth, 0.006. Lateral area hyaline. Central nodule quadrate. Furrow linear, interrupted in the middle part. *Diploneis oculata* is reported from Aokiko Lake.

DIPLONEIS ELLIPTICA (Kütz.) Cleve var. LADOGENSIS Cleve. Plate 2, figs. 3 and 6.

Diploneis elliptica (Kütz.) Cleve var. *ladogensis* CLEVE, Diatom. Finland (1893) 43, pl. 2, fig. 9.

Valve elliptic. Length, 0.027 to 0.035 mm; breadth, 0.015 to 0.023. Transverse costæ irregularly anastomosing with a few, longitudinal, undulating costæ. Known from Europe.

STAURONEIS PHŒNICENTERON Ehr. Plate 5, fig. 19.

Stauroneis phoenicenteron Ehr., FR. HUSTEDT, Bacillar. (1930) 255, fig. 404.

Valve lanceolate, with attenuate ends. Length, 0.15 mm; breadth, 0.028. Striæ 14 in 0.01 mm. Common in fresh water.

STAURONEIS PHŒNICENTERON Ehr. fo. NIPPONICA fo. nov. Plate 3, fig. 21; Plate 9, fig. 4.

Valve lanceolate, broad with acute ends. Striæ radiate and somewhat curved, 14 to 18 in 0.01 mm. Length, 0.085 to 0.11 mm; breadth, 0.024 to 0.025. Differs from the type in its short valve.

STAURONEIS ANCEPS Ehr. Plate 5, fig. 15.

Stauroneis anceps Ehr., FR. HUSTEDT, Bacillar. (1930) 256, fig. 405.

Valve lanceolate with attenuate ends. Striæ 18 in 0.01 mm. Length, 0.049 to 0.085 mm; breadth, 0.011 to 0.02. Common in fresh water.

STAURONEIS ANCEPS Ehr. fo. GRACILIS (Ehr.) Cleve. Plate 5, fig. 20.

Stauroneis anceps Ehr. fo. *gracilis* (Ehr.) Cleve, FR. HUSTEDT, Bacillar. (1930) 256, fig. 406.

Valve with long capitate ends. Length, 0.08 mm; breadth, 0.013. Striæ 15 in 0.01 mm. Rare.

STAURONEIS ANCEPS Ehr. var. LINEARIS (Ehr.) Cleve. Plate 5, fig. 14.

Stauroneis anceps Ehr. var. *linearis* (Ehr.) Cleve, FR. HUSTEDT, Bacillar. (1930) 256, fig. 407.

Valve linear with rostrate ends. Length, 0.045 mm; breadth, 0.0085. Striæ 24 in 0.01 mm. Uncommon.

STAURONEIS SMITHII Grun. Plate 3, fig. 11.

Stauroneis Smithii Grun., FR. HUSTEDT, Bacillar. (1930) 261, fig. 420.

Valve lanceolate, constricted in the middle part, rostrate at the ends. Central area a short fascia. Length, 0.016 mm; breadth, 0.0042. Common in fresh water.

STAURONEIS SMITHII Grun. var. INCISA Pantocsek. Plate 4, fig. 27.

Stauroneis Smithii Grun. var. *incisa* Pantocsek, FR. HUSTEDT, Bacillar. (1930) 261, fig. 421.

Valve lanceolate, attenuate with long ends. Length, 0.04 mm; breadth, 0.008. Striæ 24 in 0.01 mm. Rare.

STAURONEIS SMITHII Grun. var. **NIPPONICA** var. nov. Plate 10, fig. 23.

Valve slightly triundulate. Ends long, acuminate. Length, 0.034 mm; breadth, 0.0068. Striæ 28 to 30 in 0.01 mm. Differs from variety *incisa* in its undulate margins.

ANOMŒONEIS EXILIS (Kütz.) Cleve var. **NIPPONICA** var. nov. Plate 11, fig. 12.

Valve sublinear-lanceolate, asymmetrical, convex, with attenuated, obtuse ends. Length, 0.044 mm; breadth, 0.0051. Striæ indistinctly punctuate, striolate, 18 to 20 in 0.01 mm. Not common in Kizaki Lake.

NAVICULA CUSPIDATA Kütz. Plate 6, fig. 16.

Navicula cuspidata Kütz., FR. HUSTEDT, Bacillar. (1930) 268, fig. 433.

Valve lanceolate, acute. Striæ parallel, 15 in 0.01 mm. Length, 0.096 mm; breadth, 0.022. Uncommon.

NAVICULA HOLOPHILA (Grun.) Cleve fo. **MINOR** Kolbe. Plate 4, fig. 13.

Navicula holophila (Grun.) Cleve fo. *minor* KOLBE, Kieselalgen des Sperenberger Salzgebiets (1927) 67, pl. 1, fig. 4.

Valve lanceolate, acute. Striæ fine, slightly radiate; transversal striæ 18, longitudinal 30, in 0.01 mm. Axial area narrow. Length, 0.062 mm; breadth, 0.017. Known from brackish water in Europe.

NAVICULA LAPIDOSA Krasske var. **NIPPONICA** var. nov. Plate 5, fig. 12.

Valve elliptica. Striæ radiate, 18 to 19 in 0.01 mm. Central area a broad stauros, widened and truncate outwards. Axial area very narrow. Length, 0.015 mm; breadth, 0.0065. *Navicula lapidosa* is known from Europe.

NAVICULA ROTÆANA (Rahb.) Grun. Plate 4, fig. 25.

Navicula Rotæana (Rabh.) Grun., FR. HUSTEDT, Bacillar. (1930) 273, fig. 445.

Valve elliptic, rounded. Striæ fine, 20 to 25 in 0.01 mm. Central area a broad stauros. Length, 0.015 mm; breadth, 0.0068. An alpine species.

NAVICULA MUTICA Kütz. Plate 15, fig. 5.

Navicula mutica Kütz., FR. HUSTEDT, Bacillar. (1930) 274, fig. 453a.

Valve elliptic-lanceolate. Striæ distinctly punctate, 20 in 0.01 mm. Central area with an isolated punctum. Length, 0.022 mm; breadth, 0.0085. Common in fresh water.

NAVICULA PERPUSILLA Grun. Plate 9, fig. 6.

Navicula perpusilla Grun., FR. HUSTEDT, Bacillar. (1930) 278, fig. 459.

Valve broad-elliptic. Striæ very fine, 30 in 0.01 mm. Axial area broad. Length, 0.01 mm; breadth, 0.0042. Uncommon in Kizaki Lake.

NAVICULA CONFERVACEA Kütz. fo. **NIPPONICA** fo. nov. Plate 2, fig. 7; Plate 4, fig. 23.

Valve elliptic, attenuate at the ends. Striæ radiate, marginal, 15 to 16 in 0.01 mm. Axial and central areas broad-lanceolate. Length, 0.014 to 0.015 mm; breadth, 0.0068 to 0.007. *Navicula confervacea* is common in the Tropics.

NAVICULA AMERICANA Ehr. Plate 3, fig. 23.

Navicula americana Ehr., FR. HUSTEDT, Bacillar. (1930) 280, fig. 464.

Valve linear, obtuse. Length, 0.088 mm; breadth, 0.02. Striæ 15 in 0.01 mm. Not common in Kizaki Lake.

NAVICULA LAMBDA Cleve var. **DENSISTRIATA** var. nov. Plate 4, fig. 7.

Valve linear. Striæ in the middle part of the valve 24, in the ends about 30, in 0.01 mm. Length, 0.045 mm; breadth, 0.0085. The Nippon variety differs from the type in its close striæ. *Navicula Lambda* is known from Demerara River, South America.

NAVICULA PUPULA Kütz. Plate 12, fig. 15.

Navicula pupula Kütz. var. *rectangularis* (Greg.) Grun., FR. HUSTEDT, Bacillar. (1930) 281, fig. 467b.

Valve linear. Length, 0.039 mm; breadth, 0.008. Striæ 24 in 0.01 mm. Common.

NAVICULA PUPULA Kütz. var. **CAPITATA** Hustedt. Plate 4, fig. 10.

Navicula pupula Kütz. var. *capitata* HUSTEDT, Bacillar. (1930) 281, fig. 467c.

Valve with capitate ends. Striæ 14 to 20 in 0.01 mm. Length, 0.013 to 0.028 mm; breadth, 0.004 to 0.006. Not common.

NAVICULA CRUCICULA (W. Smith) Donkin var. **CAPITATA** var. nov. Plate 5, fig. 11.

Valve elliptic with capitate ends. Striæ closer towards the ends, 15 to 16 in 0.01 mm. Axial area very narrow, somewhat widened in the middle part. Length, 0.02 mm; breadth, 0.006. Differs from the type in its capitate ends.

NAVICULA AQUEDUCTÆ Krasske fo. **MINUS** Krasske. Plate 5, fig. 10.

Navicula aqueductæ Krasske fo. *minus* KRASSKE, Bacillar. Veget. Niederhessens (1925) 44, pl. 2, fig. 23.

Valve slightly siliceous, linear, constricted in the middle part, attenuate and capitate at the ends. Length, 0.014 mm; breadth, 0.0028. Reported from Europe.

NAVICULA MURALIS Grun. Plate 4, fig. 14.

Navicula muralis Grun., FR. HUSTEDT, Bacillar. (1930) 288, fig. 482.

A minute elliptical valve with rounded ends. Striæ in the middle 28 to 30, at the ends 40, in 0.01 mm. Common in fresh water.

NAVICULA ATOMARIUS sp. nov. Plate 2, fig. 13.

Valve linear, slightly convex and obtuse. Length, 0.009 mm; breadth, 0.0034. Striæ very fine, about 40 in 0.01 mm. Central area round, axial area linear and narrow. Differs from *Navicula pelliculosa* (Breb.) Hilse in its enlarged central area.

NAVICULA ATOMUS (Naegeli) Grun. var. **NIPPONICA** var. nov. Plate 10, fig. 16.

Valve elliptical. Striæ radiate, in the middle 16, at the ends 20, in 0.01 mm. Length, 0.015 mm; breadth, 0.005. *Navicula atomus* is smaller than the Nippon variety.

NAVICULA MINUSCULA Grun. Plate 11, fig. 11.

Navicula minuscula Grun., FR. HUSTEDT, Bacillar. (1930) 288, fig. 483.

Valve slightly siliceous, lanceolate. Length, 0.01 mm; breadth, 0.003. Common.

NAVICULA PUSIO Cleve. Plate 4, figs. 20 and 21; Plate 11, fig. 22.

Navicula Pusio CLEVE, Synopsis of the Navic. Diatoms (1895) 2, 9, pl. 2, fig. 3.

Valve elliptical, with broad rostrate ends. Axial area very narrow, central area small. Striæ fine, radiate, about 25 to 30 in 0.01 mm, closer towards the ends. Length, 0.014 to 0.018 mm; breadth, 0.006 to 0.008. Reported from Rotorua Lake, New Zealand, and from Aokiko Lake, Nippon.

NAVICULA PUSIO Cleve var. **ARCUATA** (Pantocsek) Skvortzow. Plate 2, fig. 35.

Navicula arcuata PANTOCSEK, Fossile Bacillarien Ungarns (1903) 3, pl. 6, fig. 97.

Valve larger than the type. Striæ very fine. Axial area narrow, widened in the middle. Length, 0.027 mm; breadth, 0.013. The typical *Navicula arcuata* has radiate striæ.

NAVICULA PSEUDOSCUTIFORMIS Hustedt. Plate 4, fig. 15.

Navicula pseudoscutiformis HUSTEDT, Bacillar. (1930) 291, fig. 495.

Valve broad-elliptical, about circular. Striæ radiate, 18 in 0.01 mm. Length, 0.0085 mm; breadth, 0.007. Known from Europe.

NAVICULA CRYPTOCEPHALA Kütz. Plate 10, fig. 3.

Navicula cryptocephala Kütz., FR. HUSTEDT, Bacillar. (1930) 295, fig. 496.

Valve lanceolate, attenuate. Striæ radiate, 18 in 0.01 mm. Length, 0.02 mm; breadth, 0.005. Common in fresh water.

NAVICULA CRYPTOCEPHALA Kütz. var. **VENETA** (Kütz.) Grun. Plate 7, fig. 14.

Navicula cryptocephala Kütz. var. *veneta* (Kütz.) Grun., FR. HUSTEDT, Bacillar. (1930) 295, fig. 497a.

Valve lanceolate, attenuate. Striæ radiate, 13 to 14 in 0.01 mm. Axial area narrow. Length, 0.023 mm; breadth, 0.005. Common in fresh water.

NAVICULA SALINARUM Grun. var. **NIPPONICA** var. nov. Plate 5, fig. 21.

Valve lanceolate, elliptical and acuminate. Striæ robust, 9 in 0.01 mm, in the middle of unequal length. Length, 0.03 mm; breadth, 0.0085. The typical *Navicula salinarum* has the striæ 14 to 16 in 0.01 mm and is known from brackish water.

NAVICULA RHYNCHOCEPHALA Kütz. Plate 5, fig. 2.

Navicula rhynchocephala Kütz., FR. HUSTEDT, Bacillar. (1930) 296, fig. 501.

Valve lanceolate with attenuate ends. Striæ radiate, 12 to 13 in 0.01 mm. Axial area narrow. Length, 0.035 mm; breadth, 0.0085. Reported from many parts of the world.

NAVICULA ROSTELLATA Kütz. Plate 5, fig. 3.

Navicula rostellata Kütz., A. SCHMIDT, Atlas Diatom. pl. 47, figs. 27–30.

Valve lanceolate with attenuate ends. Striæ radiate in the middle, of unequal length, 11 in 0.01 mm. Length, 0.035 mm; breadth, 0.0076. Known from Nippon.

NAVICULA ROSTELLATA Kütz. var. **NIPPONICA** var. nov. Plate 5, fig. 22.

Valve more attenuate with slightly capitate ends. Striæ 9 to 10 in 0.01 mm. Length, 0.028 mm; breadth, 0.006. Differs from the type in its margins and capitate ends. Uncommon.

NAVICULA RADIOSA Kütz. Plate 5, fig. 8.

Navicula radiosa Kütz., FR. HUSTEDT, Bacillar. (1930) 299, fig. 513.

Valve narrow-lanceolate, acuminate. Striæ 9 in 0.01 mm. Length, 0.072 mm; breadth, 0.01. Common in fresh water.

NAVICULA MENISCULUS Schumann. Plate 5, fig. 16.

Navicula menisculus Schumann, FR. HUSTEDT, Bacillar. (1930) 301, fig. 517.

Valve lanceolate, broad. Striæ robust, not lineolate, 9 in 0.01 mm, of unequal length in the middle. Central area broad. Length, 0.045 mm; breadth, 0.013. Common.

NAVICULA GLOBULIFERA Hustedt. Plate 5, fig. 7.

Navicula globulifera HUSTEDT, Bacillar. aus dem Aokikosee in Japan 164, pl. 5, fig. 7.

Valve lanceolate with capitate ends. Striæ divergent in the middle, convergent at the ends. The middle striæ 8 to 9, the end striæ 14, in 0.01 mm. Length, 0.068 mm; breadth, 0.01. Only known from Nippon.

NAVICULA GLOBULIFERA Hustedt var. NIPPONICA var. nov. Plate 3, fig. 10.

Valve more elongate with noncapitate ends. Striæ 12 in 0.01 mm. Length, 0.083 mm; breadth, 0.01. Differs from the type in its attenuate and noncapitate ends.

NAVICULA FALAISIENSIS Grun. var. LANCEOLA Grun. Plate 5, fig. 9.

Navicula falaisiensis Grun. var. *lanceola* Grun., FR. HUSTEDT, Bacillar. (1930) 302, fig. 524.

Valve linear-lanceolate with rounded and truncate ends. Striæ fine, radiate, 18 to 22 in 0.01 mm. Axial area very narrow. Central area small. Length, 0.017 mm; breadth, 0.005. Reported from slightly brackish and fresh waters.

NAVICULA FALAISIENSIS Grun. var. NIPPONICA var. nov. Plate 6, fig. 15.

Valve lanceolate, rostrate. Striæ fine, slightly radiate, 18 in 0.01 mm. Axial area very narrow. Differs from the type in its subrostrate or rostrate ends and different number of striæ.

NAVICULA DICEPHALA (Ehr.) W. Smith. Plate 3, fig. 4.

Navicula dicephala (Ehr.) W. Smith, FR. HUSTEDT, Bacillar. (1930) 302, fig. 526.

Valve linear-lanceolate with rostrate ends. Striæ radiate, 11 in 0.01 mm. Length, 0.032 mm; breadth, 0.012. Common.

NAVICULA EXIGUA (Greg.) O. Mull. Plate 4, fig. 9.

Navicula exigua (Greg.) O. Mull., FR. HUSTEDT, Bacillar. (1930) 305, fig. 538.

Valve linear-lanceolate with capitate ends. Striæ 16 in 0.01 mm. Length, 0.017 mm; breadth, 0.005. A fresh-water diatom.

NAVICULA SIMILIS Krasske. Plate 5, fig. 13.

Navicula similis Krasske, FR. HUSTEDT, Bacillar. (1930) 303, fig. 528.

Valve minute, lanceolate with acute ends. Striæ distinct, 15 in 0.01 mm. Axial and central areas narrow. Length, 0.01 mm; breadth, 0.005. Reported from Europe.

NAVICULA ANGLICA Ralfs. Plate 5, fig. 18.

Navicula anglica Ralfs., FR. HUSTEDT, Bacillar. (1930) 303, figs. 530–531.

Valve elliptic with rostrate ends. Striæ slightly radiate, 12 to 13 in 0.01 mm. Axial area narrow, widened in the middle part. Length, 0.022 mm; breadth, 0.008. Common in fresh water.

NAVICULA PLACENTULA (Ehr.) Grun. fo. ROSTRATA A. Mayer. Plate 5, fig. 5.

Navicula placentula (Ehr.) Grun. fo. *rostrata* A. Mayer, FR. HUSTEDT, Bacillar. (1930) 304, fig. 533.

Valve elliptic-lanceolate with rostrate ends. Striæ robust, 7 in 0.01 mm. Length, 0.062 mm; breadth, 0.023. Reported from Europe, Siberia, New Zealand, and America.

NAVICULA PLACENTULA (Ehr.) Grun. fo. NIPPONICA fo. nov. Plate 10, fig. 20.

Valve robust, short-lanceolate with rostrate ends. Striæ 12 in 0.01 mm. Length, 0.024 mm; breadth, 0.012. This form differs from form *rostrata* Mayer in its shorter valve.

NAVICULA LANCEOLATA (Agardh) Kütz. Plate 5, fig. 4; Plate 10, fig. 5.

Navicula lanceolata (Agardh) Kütz., FR. HUSTEDT, Bacillar. (1930) 305, fig. 540.

Valve lanceolate, acuminate. Striæ lineolate, 9 to 12 in 0.01 mm. Length, 0.059 to 0.06 mm; breadth, 0.0085 to 0.01. Known from Nippon.

NAVICULA LANCEOLATA (Agardh) Kütz. var. CYMBULA (Donk.) Cleve. Plate 5, fig. 17.

Navicula lanceolata (Agardh) Kütz. var. *cymbula* (Donk.) Cleve, VAN HEURCK, Synopsis pl. 7, fig. 32.

Valve lanceolate, acuminate. Striæ radiate, lineate, widened, in the middle 5, at the ends 8, in 0.01 mm. Length, 0.085 mm; breadth, 0.013. Reported from Nippon.

NAVICULA HASTA Pantocsek. Plate 5, fig. 1.

Navicula hasta PANTOCSEK, Fossil. Diatom. Ungarn (1903) 3, pl. 5, fig. 74; pl. 14, fig. 213.

Valve lanceolate with attenuate, not cuneate, rounded ends. Striæ lineate, robust, 7 to 8 in 0.01 mm, radiate, widened in the middle part. Length, 0.096 mm; breadth, 0.017. Our specimens are different from the forms described by Fr. Meister from Nojiri and Suwa Lakes in Nippon.

NAVICULA PEREGRINA (Ehr.) Kütz. var. CUNEATA var. nov. Plate 5, fig. 24.

Valve lanceolate, broad with cuneate ends. Striæ radiate divergent at the ends, 9 in 0.01 mm. Length, 0.049 mm;

breadth, 0.0085. Differs from the type in its broad valve and its ends.

NAVICULA LACUSTRIS Greg. Plate 5, fig. 6; Plate 8, fig. 9.

Navicula lacustris Greg., CLEVE, Diatoms Finland (1893) 34, pl. 2, figs. 3, 12, 14.

Valve elliptical and acuminate. Striæ punctate. Length, 0.02 to 0.044 mm; breadth, 0.01 to 0.015. Striæ 16 in 0.01 mm. Reported from Europe, Asia, and America.

NAVICULA AMPHIBOLA Cleve. Plate 9, fig. 20.

Navicula amphibola Cleve, FR. HUSTEDT, Bacillar. (1930) 309–310, fig. 554.

Valve lanceolate with attenuate ends. Striæ punctate, 12 in 0.01 mm. Length, 0.047 mm; breadth, 0.017. Not common in Kizaki Lake.

NAVICULA PALEA sp. nov. Plate 8, fig. 4.

Valve linear, lanceolate, narrow-attenuate with slightly capitate ends. Striæ fine, radiate, 15 to 16 in 0.01 mm. Axial and central areas narrow and linear. Length, 0.029 mm; breadth, 0.0037. Differs from *Navicula radiosa, N. cari,* and *N. cincta* in its narrow central area and capitate ends.

NAVICULA KIZAKENSIS sp. nov. Plate 16, fig. 12.

Valve minute, lanceolate, rounded in the middle, attenuate and capitate at the ends. Striæ radiate, about 30 in 0.01 mm. Axial area narrow, linear, widened in the middle part. Length, 0.011 mm; breadth, 0.0042. Differs from *Navicula Schadei* Krasske [1] in its narrow central area and coarser striæ.

NAVICULA BREHMI Hustedt fo. ELONGATA fo. nov. Plate 3, fig. 2.

Valve linear-elliptic with parallel margins and cuneate ends. Striæ parallel, coarse, 18 to 20 in 0.01 mm. Axial area narrow, linear, widened in the middle part. Length, 0.032 mm; breadth, 0.0068. Differs from the type in its longer valves. The type is reported from Aokiko Lake, Nippon.

PINNULARIA LEPTOSOMA Grun. Plate 9, fig. 8.

Pinnularia leptosoma Grun., FR. HUSTEDT, Bacillar. (1930) 316, fig. 567.

Valve linear, narrowed towards the ends. Striæ radiate, 15 in 0.01 mm. Length, 0.032 mm; breadth, 0.005. A freshwater species, especially of alpine regions.

[1] Beiträge zur Kenntniss der Diatomeenflora Sachsens (1929) 355, fig. 11a, b.

PINNULARIA LEPTOSOMA Grun. var. NIPPONICA var. nov. Plate 8, fig. 15.

Valve linear, attenuate. Striæ fine, 14 in 0.01 mm. Axial area narrow, central area a broad fascia. Length, 0.066 mm; breadth, 0.0068. Differs from the type in its longer valves.

PINNULARIA MOLARIS Grun. Plate 6, fig. 13.

Pinnularia molaris Grun., FR. HUSTEDT, Bacillar. (1930) 316, fig. 568.

Valve minute, lanceolate, with radiate striæ 18 in 0.01 mm. Length, 0.025 mm; breadth, 0.005. Common in fresh water.

PINNULARIA MESOLEPTA (Ehr.) W. Smith. Plate 3, fig. 19; Plate 12, fig. 11.

Pinnularia mesolepta (Ehr.) W. Smith., FR. HUSTEDT, Bacillar. (1930) 319, fig. 575.

Valve triundulate with capitate ends. Striæ radiate, 10 to 12 in 0.01 mm. Length, 0.022 mm; breadth, 0.006 to 0.012. Common.

PINNULARIA DIVERGENTISSIMA Grun. Plate 12, fig. 24.

Pinnularia divergentissima Grun., VAN HEURCK, Synopsis (1880–1881) pl. 6, fig. 32.

Valve linear, attenuate towards the ends. Striæ strong, radiate, 15 in 0.01 mm, with a broad fascia. Length, 0.047 mm; breadth, 0.0068. Uncommon.

PINNULARIA MICROSTAURON (Ehr.) Cleve. Plate 7, fig. 6.

Pinnularia microstauron (Ehr.) Cleve, FR. HUSTEDT, Bacillar. (1930) 320, fig. 582.

Valve linear-lanceolate with parallel margins and rounded subrostrate ends. Striæ radiate, 10 in 0.01 mm. Length, 0.056 mm; breadth, 0.01. Common.

PINNULARIA MICROSTAURON (Ehr.) Cleve var. AMBIGUA Meister fo. DIMINUTA Grun. Plate 7, fig. 18.

Pinnularia microstauron (Ehr.) Cleve var. *ambigua* Meister fo. *diminuta* Grun., FR. HUSTEDT, Bacillar. (1930) 321–322, fig. 585.

Valve lanceolate. Striæ radiate, 14 in 0.01 mm. Length, 0.03 mm; breadth, 0.006. Common in fresh water.

PINNULARIA MICROSTAURON (Ehr.) Cleve var. NIPPONICA var. nov. Plate 6, fig. 8; Plate 9, fig. 10.

Valve undulate with obtuse ends. Striæ 10 to 11 in 0.01 mm. Length, 0.045 to 0.056 mm; breadth, 0.0085 to 0.011. Differs from the type in its broad obtuse ends.

PINNULARIA MICROSTAURON (Ehr.) Cleve var. KIZAKENSIS var. nov. Plate 6, fig. 7.

Valve with parallel margins and attenuate ends. Striæ robust, 9 to 13 in 0.01 mm. Central area a broad fascia. Length,

0.034 to 0.062 mm; breadth, 0.0083 to 0.013. Differs from the type in its attenuate ends. Common in Kizaki Lake.

PINNULARIA KARELICA Cleve var. JAPONICA Hustedt. Plate 6, fig. 4.

Pinnularia karelica Cleve var. *japonica* HUSTEDT, Bacillar. d. Aokikosee in Japan 165, pl. 5, fig. 3.

A distinct form with slightly capitate ends. Striæ 14 in 0.01 mm, crossed by a band. Length, 0.061 mm; breadth, 0.012. Known from Aokiko Lake.

PINNULARIA KARELICA Cleve var. JAPONICA Hustedt fo. OBTUSA fo. nov. Plate 6, fig. 3.

A small obtuse form, with striæ 12 to 13 in 0.01 mm, with narrow axial area. Length, 0.044 mm; breadth, 0.013. Uncommon.

PINNULARIA KARELICA Cleve var. INSULARIS var. nov. Plate 6, fig. 12.

Valve linear with capitate ends. Striæ 8 to 9 in 0.01 mm, crossed by a narrow band. Central area elliptical. Differs from variety *japonica* Hustedt in its broad axial area and larger valve.

PINNULARIA LEGUMEN Ehr. Plate 8, fig. 6.

Pinnularia legumen Ehr., FR. HUSTEDT, Bacillar. (1930) 322, fig. 587.

Valve strongly triundulate with capitate ends. Striæ 8 in 0.01 mm. Length, 0.088 mm; breadth, 0.014. Reported from Nippon.

PINNULARIA LEGUMEN Ehr. var. NIPPONICA var. nov. Plate 7, fig. 4.

Valve with slightly undulate margins. Striæ 10 in 0.01 mm. Length, 0.078 mm; breadth, 0.015. Differs from the type in its broader and more obtuse valve.

PINNULARIA PLATYCEPHALA (Ehr.) Cleve. Plate 6, fig. 1.

Pinnularia platycephala (Ehr.) Cleve, FR. HUSTEDT, Bacillar. (1930) 324, fig. 593.

A robust species with triundulate margins. Striæ divergent in the middle, convergent at the ends, 8 in 0.01 mm. Length, 0.09 mm; breadth, 0.019. Common in lakes.

PINNULARIA PLATYCEPHALA (Ehr.) Cleve var. HATTORIANA Meister. Plate 6, fig. 2.

Pinnularia platycephala (Ehr.) Cleve var. *Hattoriana* MEISTER, Beiträge zur Bacillar. Japans (1914) 2, 228–229, pl. 8, figs. 6, 7.

A distinct diatom with capitate ends and large comma-shaped terminal fissures. Length, 0.079 mm; breadth, 0.01. Striæ 8 in 0.01 mm. This diatom was named by Dr. Fr. Meister in

honor of D. Hattori, of the Botanical Institute, Imperial University, Tokyo.

PINNULARIA MONTANA Hustedt fo. **MINOR** fo. nov. Plate 9, fig. 9.

Valve lanceolate. Striæ short, 8 to 9 in 0.01 mm. Length, 0.051 to 0.068 mm; breadth, 0.012 to 0.015. Longitudinal band indistinct. The typical *Pinnularia montana* was described from Aokiko Lake and is twice as large (length, 0.12 to 0.15 mm).

PINNULARIA BREVICOSTATA Cleve. Plate 12, fig. 1.

Pinnularia montana Hustedt var. *sinica* SKVORTZOW, Alpine diatoms of South China (1929) 43, pl. 2, fig. 14; pl. 3, fig. 13.

Valve linear with obtuse ends. Striæ parallel, with a longitudinal band, 10 to 11 in 0.01 mm. Length, 0.105 mm; breadth, 0.017. Reported from Foochow, southern China.

PINNULARIA GIBBA Ehr. Plate 7, figs. 2 and 3.

Pinnularia gibba Ehr., FR. HUSTEDT, Bacillar. (1930) 327, fig. 600a, b.

Valve lanceolate with capitate ends. Central area a broad fascia. Length, 0.066 to 0.068 mm; breadth, 0.008 to 0.01. Striæ 9 to 11 in 0.01 mm. Common in fresh water.

PINNULARIA GIBBA Ehr. fo. **SUBUNDULATA** Mayer. Plate 7, fig. 15.

Pinnularia gibba Ehr. fo. *subundulata* Mayer, FR. HUSTEDT, Bacillar. (1930) 327, fig. 601.

Valve slightly triundulate with rostrate, minutely capitate ends. Striæ divergent in the middle, convergent at the ends, 8 in 0.01 mm. Length, 0.069 mm; breadth, 0.01. Common.

PINNULARIA GIBBA Ehr. var. **NIPPONICA** var. nov. Plate 7, fig. 10.

Valve slightly triundulate, ends little capitate. Striæ radiate, 12 in 0.01 mm. Central area round. Length, 0.095 mm; breadth, 0.013. Differs from the type in its triundulate margins.

PINNULARIA OKAMURÆ sp. nov. Plate 7, fig. 13.

Valve linear with attenuate ends. Striæ divergent in the middle part, convergent at the ends, 11 to 12 in 0.01 mm. Length, 0.061 mm; breadth, 0.008. A species related to *Pinnularia gibba* var. *linearis* Hustedt. Named in honor of the late Prof. Dr. K. Okamura, director of the Imperial Fisheries Institute, Tokyo.

PINNULARIA BOREALIS Ehr. Plate 7, fig. 17; Plate 16, fig. 15.

Pinnularia borealis Ehr., FR. HUSTEDT, Bacillar. (1930) 326, fig. 597.

Valve linear-elliptic with rounded ends. Striæ radiate, 5 to 7 in 0.01 mm. Length, 0.027 mm; breadth, 0.0068 to 0.009. Com-

mon on mosses, moist earth, and in fresh water. Known from Nippon.

PINNULARIA BALFOURIANA Grun. var. **STAUROPTERA** var. nov. Plate 16, fig. 14.

A minute form with radiate striæ, 9 to 10 in 0.01 mm, which form a stauros in the middle part of the valve. Length, 0.017 mm; breadth, 0.005. Rare. Differs from the type in its larger size and a stauros in the middle part of the valve.

PINNULARIA LIGNITICA Cleve. Plate 10, fig. 26.

Pinnularia lignitica CLEVE, Synopsis Navicul. Diatoms (1895) 2, 85, pl. 1, fig. 15.

A distinct species with rhombic valve, short striæ 11 to 12 in 0.01 mm, and a broad central area. Length, 0.062 mm; breadth, 0.018. Longitudinal band distinct. Common in Kizaki Lake. Reported as a fossil from Nippon lignite (Brun collections).

PINNULARIA TABELLARIA Ehr. Plate 9, fig. 5.

Pinnularia tabellaria Ehr., A. SCHMIDT, Atlas Diatom. pl. 43, fig. 4.

Valve linear, slightly gibbous in the middle. Striæ parallel, convergent at the ends, 10 in 0.01 mm. Axial area linear, central area elliptic. Length, 0.244 mm; breadth, 0.019. Known from North America, Brazil, Siberia, and South Africa.

PINNULARIA HUSTEDTII Meister. Plate 8, fig. 5.

Pinnulara Hustedtii MEISTER, Seltene und neue Kieselalgen (1934) 102, fig. 82.

Valve linear with capitate ends. Axial area linear, widened in the middle. Striæ 9 in 0.01 mm. Length, 0.221 mm; breadth, 0.017. Reported only from Canton River, southern China.

PINNULARIA MAJOR (Kütz.) Cleve. Plate 6, fig. 10.

Pinnularia major (Kütz.) Cleve, FR. HUSTEDT, Bacillar. (1930) 331, 614.

Valve linear, slightly gibbous in the middle. Length, 0.161 mm; breadth, 0.022. Striæ 7 in 0.01 mm. Common in fresh water. Known from Nippon.

PINNULARIA MAJOR (Kütz.) Cleve var. **LINEARIS** Cleve. Plate 7, fig. 11.

Pinnularia major (Kütz.) Cleve var. *linearis* Cleve, PANTOCSEK, Fossile Bacillarien Ungarns (1905) 3, pl. 7, fig. 113.

Valve broad-linear with parallel margins. Striæ 9 in 0.01 mm. Length, 0.127 mm; breadth, 0.02. Common.

PINNULARIA VIRIDIS (Nitzsch) Ehr. var. **LEPTOGONGYLA** (Ehr. Grun.) Cleve. Plate 6, fig. 11.

Pinnularia leptogongyla A. SCHMIDT, Atlas Diatom. (1876) pl. 45, figs. 26–28.

Valve linear with attenuate ends. Striæ 7 to 8.5 in 0.01 mm, with a distinct band. Central area broad, axial area one-third of the breadth of the valve. Known from brackish waters of Europe.

PINNULARIA VIRIDIS (Nitzsch) Ehr. var. **INTERMEDIA** Cleve. Plate 7, fig. 9.

Pinnularia sp. A. SCHMIDT, Atlas Diatom. (1876) pl. 42, figs. 9–10.

Valve large with two longitudinal bands. Central area broad. Length, 0.105 mm; breadth, 0.017. Striæ 8 to 9 in 0.01 mm. Common in fresh water.

PINNULARIA VIRIDIS (Nitzsch) Ehr. var. **FALLAX** Cleve. Plate 9, fig. 7; Plate 12, fig. 18.

Navicula sp. A. SCHMIDT, Atlas Diatom. (1876) pl. 43, fig. 24; pl. 45, figs. 10–11.

Valve linear, narrowed towards the ends. Striæ 9 to 11 in 0.01 mm, without longitudinal band. Central area with a short stauros or shortened striæ. Length, 0.045 to 0.049 mm; breadth, 0.01. Common.

PINNULARIA VIRIDIS (Nitzsch) Ehr. var. **SUDETICA** (Hilse) Hustedt. Plate 9, fig. 21.

Pinnularia viridis (Nitzsch) Ehr. var. *sudetica* (Hilse) HUSTEDT, Bacillar. (1930) 335, fig. 617b.

A form with coarse striæ, 9 in 0.01 mm, with a longitudinal band. Axial and central areas linear. Known from fresh water in Europe.

PINNULARIA VIRIDIS (Nitzsch) Ehr. var. **NIPPONICA** var. nov. Plate 6, fig. 14; Plate 8, fig. 2.

Valve lanceolate with complex median line. Striæ 6 to 7.5 in 0.01 mm. Length, 0.081 to 0.09 mm; breadth, 0.018. This new variety differs from the type in its striæ without the longitudinal band. Common in Kizaki Lake.

PINNULARIA UENO sp. nov. Plate 7, fig. 1.

Valve boat-shaped, elliptic-lanceolate with parallel margins and obtuse, subrostrate ends. Striæ robust, radiate, dilated in the middle to a transverse fascia, 9 in 0.01 mm. Median line slightly arcuate. Terminal fissures comma-shaped. Axial area somewhat dilated in the middle. Central pores distinct. Length, 0.062 mm; breadth, 0.013. Named in honor of Dr. Masujo Ueno, of Otsu, Nippon.

PINNULARIA NIPPONICA sp. nov. Plate 7, fig. 12.

Valve slightly triundulate, with truncate ends. Striæ robust, radiate, 8 in 0.01 mm. Central area a fascia. Median line flexuose. Terminal fissures comma-shaped. Axial areas linear. Length, 0.072 mm; breadth, 0.013. Uncommon.

PINNULARIA DACTYLUS Ehr. var. **DARIANA** A. S. fo. **NIPPONICA** fo. nov. Plate 7, fig. 5.

Valve lanceolate with obtuse ends. Length, 0.122 mm; breadth, 0.22. Median line not complex. Axial area broad, widened in the middle part. Striæ divergent in the middle, convergent at the ends, 8 in 0.01 mm. The type form has the valve 0.18 to 0.21 mm in length with striæ, crossed by a broad band. Variety *Dariana* is reported from America.

PINNULARIA NOBILIS Ehr. Plate 10, fig. 1.

Pinnularia nobilis Ehr., FR. HUSTEDT, Bacillar. (1930) 337, fig. 619.

Valve linear, slightly gibbous in the middle, with rounded ends. Length, 0.204 mm; breadth, 0.03. Striæ 6 in 0.01 mm. Common.

PINNULARIA HARTLEYANA Greville. Plate 6, fig. 5.

Pinnularia Hartleyana GREVILLE, Descriptions of new and rare diatoms, T. M. S. 13 (1865) pl. 6, fig. 30; A. SCHMIDT, Atlas Diatom. (1913) pl. 33, figs. 1, 2; G. B. DE TONI and E. L. FORTI, Alghe di Australia, Tasmania e Nuova Zelanda (1923) 145, fig. 6.

Valve robust, undulate in the middle and on the ends. Length, 0.12 mm; breadth, 0.015. Ends cuneate. Striæ divergent in the middle, convergent at the ends, 9 in 0.01 mm. Central area a rectangular fascia. Axial area enlarged around the central nodule and expanded at the ends. The Nippon form is smaller than the type. *Pinnularia Hartleyana* has been reported from Liberia and Kalahari in Africa, Demerara River in South America, Wakarevareva in New Zealand, and Aokiko Lake in Nippon.

AMPHORA OVALIS Kütz. fo. **GRACILIS** (Ehr.) Cleve. Plate 3, fig. 16.

Amphora sp. A. SCHMIDT, Atlas Diatom. (1875) pl. 26, fig. 101.

Frustule elliptic. Length, 0.02 mm; breadth, 0.0085. Striæ 16 in 0.01 mm. Common in fresh water.

AMPHORA OVALIS Kütz. var. **PEDICULUS** Kütz. Plate 3, fig. 14.

Amphora ovalis Kütz. var. *pediculus* Kütz., FR. HUSTEDT, Bacillar. (1930) 343, fig. 629.

Frustule elliptic. Valve lunate. Length, 0.012 mm; breadth, 0.0076. Striæ 18 in 0.01 mm. Common in fresh and brackish waters. Known from Nippon.

AMPHORA OVALIS Kütz. var. **LIBYCA** (Ehr.) Cleve. Plate 3, fig. 17.

Amphora libyca Ehr. A. SCHMIDT, Atlas Diatom. (1875) pl. 26, fig. 105.

Valve lunate. Length, 0.035 mm; breadth, 0.0068. Striæ 14 in 0.01 mm. Median line arcuate. Central area distinct, on the dorsal side frequently uniting with a blank band across the striæ. Common in fresh and brackish waters.

AMPHORA PERPUSILLA Grun. Plate 3, fig. 13.

Amphora perpusilla Grun., FR. HUSTEDT, Bacillar. (1930) 343, fig. 627.

Frustule elliptic. Length, 0.005 mm; breadth, 0.0025. Common in fresh water and moist earth.

AMPHORA NORMANII Rabh. Plate 3, fig. 18.

Amphora Normanii Rabh., FR. HUSTEDT, Bacillar. (1930) 343, fig. 630.

Frustule elliptic, truncate. Valve narrow, lunate, and capitate. Central nodule strong. Length, 0.024 mm; breadth, 0.0034. Striæ 18 to 20 in 0.01 mm. Common in moist earth.

AMPHORA DELPHINEA (Bailey) A. S. var. **MINOR** Cleve. Plate 3, fig. 12.

Amphora delphinea Bailey, A. SCHMIDT, Atlas Diatom. (1876) pl. 40, fig. 25.

Frustule elliptic-rectangular, with parallel margins. Length, 0.047 to 0.05 mm; breadth, 0.015. Valve linear with rounded ends. Central nodule dilated to a stauros. Median line arcuate. Striæ almost parallel, 24 in 0.01 mm. Known from Crane Pond, North America, and from Demerara River, South America. Common in Kizaki Lake.

CYMBELLA MICROCEPHALA Grun. Plate 11, fig. 25.

Cymbella microcephala Grun., FR. HUSTEDT, Bacillar. (1930) 351, fig. 637.

Valve linear with rostrate-capitate ends. Length, 0.017 mm; breadth, 0.0034. Striæ very fine, 28 in 0.01 mm. Common in fresh water.

CYMBELLA ALPINA Grun. Plate 12, fig. 12.

Cymbella alpina Grun., A. SCHMIDT, Atlas Diatom. (1931) pl. 373, fig. 17.

Valve slightly asymmetrical, lanceolate. Length, 0.049 mm; breadth, 0.01. Striæ 8 in 0.01 mm. Common in alpine regions.

CYMBELLA REINHARDTII Grun. Plate 10, fig. 14.

Cymbella Reinhardtii Grun., FR. HUSTEDT, Bacillar. (1930) 354, fig. 644.

Valve slightly asymmetrical, elliptic-lanceolate, with convex dorsal and ventral margins. Axial and central areas broad.

Length, 0.032 mm; breadth, 0.009. Striæ 15 in 0.01 mm. Known from Europe.

CYMBELLA EHRENBERGII Kütz. Plate 11, fig. 3.

Cymbella Ehrenbergii Kütz., FR. HUSTEDT, Bacillar. (1930) 356, fig. 656.

Valve elliptic-lanceolate. Length, 0.105 mm; breadth, 0.037. Striæ 9 in 0.01 mm. Common in fresh water.

CYMBELLA NAVICULIFORMIS Auerswald. Plate 11, fig. 6.

Cymbella naviculiformis Auerswald, FR. HUSTEDT, Bacillar. (1930) 356–357, fig. 653.

Valve naviculiform, lanceolate with capitate and constricted ends. Length, 0.032 mm; breadth, 0.0085. Striæ 12 in 0.01 mm. Central area circular. Common in Kizaki Lake. Known from alpine regions.

CYMBELLA CUSPIDATA Kütz. Plate 11, fig. 23.

Cymbella cuspidata Kütz., A SCHMIDT, Atlas Diatom. (1931) pl. 374, figs. 13, 14.

Valve slightly asymmetrical with rostrate-capitate ends. Length, 0.034 to 0.074 mm; breadth, 0.012 to 0.02. Striæ 8 in 0.01 mm. Known from Nippon.

CYMBELLA HETEROPLEURA Ehr. var. **MINOR** Cleve. Plate 11, fig. 4.

Cymbella sp. A. SCHMIDT, Atlas Diatom. (1875) pl. 9, figs. 51, 52.

Valve slightly asymmetrical, lanceolate with rostrate ends. Length, 0.074 mm; breadth, 0.022. Central area large. Striæ 8 in 0.01 mm. Known from fresh waters of far-northern regions.

CYMBELLA HETEROPLEURA Ehr. fo. **NIPPONICA** fo. nov. Plate 11, fig. 13.

Valve linear-lanceolate, attenuate, and with truncate ends. Length, 0.04 mm; breadth, 0.01. Striæ 8 to 9 in 0.01 mm, not lineate. Axial area linear, central area orbicular. Differs from the type in its small valve.

CYMBELLA PROSTRATA (Berkeley) Cleve. Plate 10, fig. 33.

Cymbella prostrata (Berkeley) Cleve, FR. HUSTEDT, Bacillar. (1930) 357–358, fig. 659.

Valve asymmetrical with elevated dorsal and triundulate ventral margins. Median line arcuate with long terminal fissures. Axial area lanceolate. Striæ punctate, 7 ventral, 6 dorsal, in 0.01 mm. Common in fresh and brackish waters.

CYMBELLA TURGIDA (Greg.) Cleve. Plate 11, fig. 20.

Cymbella turgida (Greg.) Cleve, FR. HUSTEDT, Bacillar. (1930) 358, fig. 660.

Valve lunate, with arcuate dorsal margin, slightly gibbous ventral margin. Length, 0.054 mm; breadth, 0.014. Striæ 6 in 0.01 mm. Known from Aokiko Lake. Common in tropical regions.

CYMBELLA VENTRICOSA Kütz. Plate 11, figs. 8, 14, and 18.

Cymbella ventricosa Kütz., FR. HUSTEDT, Bacillar. (1930) 359, fig. 661.

Valve lunate with straight or slightly gibbous ventral margin. Length, 0.025 to 0.032 mm; breadth, 0.006 to 0.007. Striæ 10 to 12 in 0.01 mm. Very common in fresh water.

CYMBELLA GRACILIS Rabh. Plate 11, fig. 5.

Cymbella gracilis Rabh., VAN HEURCK, Synopsis (1880–1881) pl. 3, figs. 20–21.

Valve narrow with slightly arcuate dorsal, and straight ventral, margins. Length, 0.062 mm; breadth, 0.008. Striæ 12 in 0.01 mm. Found in fresh water, especially in alpine regions.

CYMBELLA GRACILIS (Rabh.) Cleve fo. MINOR fo. nov. Plate 12, fig. 22.

Like the type, but smaller. Length, 0.018 mm; breadth, 0.045. Striæ 12 in 0.01 mm. Median line approximate to the ventral margin. Uncommon.

CYMBELLA ÆQUALIS W. Smith. Plate 3, fig. 5; Plate 11, fig. 2.

Cymbella obtusa Greg., A. SCHMIDT, Atlas Diatom. (1875) pl. 9, figs. 41–45.

Valve naviculiform and subclavate. Length, 0.032 to 0.042 mm; breadth, 0.0065 to 0.009. Striæ radiate, 12 to 15 in 0.01 mm. Common in alpine regions. Known from Aokiko Lake.

CYMBELLA SINUATA Greg. Plate 11, fig. 15.

Cymbella sinuata Greg., FR. HUSTEDT, Bacillar. (1930) 361, fig. 668a.

Valve linear, slightly asymmetrical, gibbous in the middle with obtuse ends. Length, 0.02 mm; breadth, 0.005. Striæ 12 in 0.01 mm. Reported from Aokiko Lake.

CYMBELLA SINUATA Greg. var. ANTIQUA Grun. Plate 9, fig. 17.

Cymbella sinuata Greg. var. *antiqua* Grun., PANTOCSEK, Fossile Bacillar. Ungarns (1905) 141, pl. 29, fig. 31.

Valve linear with capitate ends. Length, 0.018 mm; breadth, 0.0068. Striæ 5 to 6 in 0.01 mm. The typical variety *antiqua* is larger, being 0.032 to 0.033 mm in length. Known only as a fossil from Hungary.

CYMBELLA TURGIDULA Grun. Plate 11, fig. 24.

Cymbella turgidula Grun., A. SCHMIDT, Atlas Diatom. (1875) pl. 9, figs. 23–26.

Valve asymmetrical with rostrate and obtuse ends. Length, 0.029 mm; breadth, 0.011. Striæ 9 to 10 in 0.01 mm. On the ventral side of the central nodule are two puncta. Known from the Tropics.

CYMBELLA AFFINIS Kütz. Plate 11, figs. 9 and 10.

Cymbella affinis Kütz., FR. HUSTEDT, Bacillar. (1930) 362, fig. 671.

Valve cymbiform with truncate ends. Length, 0.035 to 0.039 mm; breadth, 0.0085 to 0.012. Striæ 8 to 10 in 0.01 mm. Known from Nippon.

CYMBELLA HYBRIDA Grun. Plate 5, fig. 23.

Cymbella hybrida Grun., CLEVE, Synopsis Navicul. Diatoms (1894) 1, 166, pl. 4, fig. 23.

Navicula rhynchocephala Kütz. var. *hankensis* SKVORTZOW, Diatoms Hanka Lake (1929) 49, pl. 4, fig. 22.

Valve naviculiform, linear with parallel margins and truncate ends. Striæ lineolate, divergent in the middle, convergent at the ends, 9 in 0.01 mm. The median striæ, opposite the stigma, shortened. Axial area narrow, linear widened in the middle. Length, 0.068 mm; breadth, 0.0085. Known from fresh water and very slightly brackish water in Sweden, reported from Hanka Lake, Siberia. Common in Kizaki Lake.

CYMBELLA JAPONICA Reichelt. Plate 10, fig. 4; Plate 11, figs. 1 and 7.

Cymbella japonica Reichelt, A. SCHMIDT, Atlas Diatom. (1931) pl. 373, figs. 29–31.

Cymbella signata Pant. var. *chinensis* SKVORTZOW, Alpine diatoms from South China (1929) 46, pl. 2, fig. 21.

Valve sublinear, subclavate with attenuate, rounded ends. Length, 0.042 to 0.08 mm; breadth, 0.012 to 0.014. Striæ robust, slightly radiate, 6.5 to 8 in 0.01 mm, distinctly lineolate. Median line arcuate, broad with reflexed terminal fissures. Near the central nodule one stigma. Known from Yokohama on mosses, in Aokiko Lake, and common in Kizaki Lake. Reported from a mountain stream near Foochow, southern China.

CYMBELLA CYMBIFORMIS (Agardh, Kütz.) Van Heurck. Plate 11, fig. 21.

Cymbella cymbiformis (Agardh, Kütz.) Van Heurck, FR. HUSTEDT, Bacillar. (1930) 362, fig. 672.

Valve boat-shaped, with slightly gibbous ventral margin and obtuse, truncate ends. Length, 0.051 to 0.076 mm; breadth,

0.0085 to 0.015. Striæ 7 to 10 in 0.01 mm. At the ventral side of the central nodule a distinct isolated punctum. Common in fresh water. Known from Nippon.

CYMBELLA CISTULA (Hemprich) Grun. Plate 3, fig. 20.

Cymbella cistula (Hemp.) Grun., VAN HEURCK, Synopsis (1880–1881) pl. 2, fig. 2.

Valve cymbiform. Length, 0.059 to 0.093 mm; breadth, 0.013 to 0.017. On ventral side one or two isolated puncta. Common in fresh water.

CYMBELLA ASPERA (Ehr.) Cleve var. TRUNCATA (Rabh.) Dippel. Plate 9, fig. 19.

Cymbella gastroides var. *truncata* (Rabh.) Dippel, A. MAYER, Die Bacillar. d. Regensburger Gewässer (1913) 262, pl. 13, fig. 20.

Valve cymbiform with truncate ends. Length, 0.13 mm; breadth, 0.025. Striæ 8 in 0.01 mm. Common.

CYMBELLA TUMIDA (Breb.) Van Heurck. Plate 11, fig. 17.

Cymbella tumida (Breb.) Van Heurck, FR. HUSTEDT, Bacillar. (1930) 366, fig. 677.

Valve boat-shaped with rostrate-truncate ends. Length, 0.057 mm; breadth, 0.017. Striæ 9 in 0.01 mm. Reported from Nippon.

CYMBELLA TUMIDA (Breb.) Van Heurck var. BOREALIS Grun. Plate 11, fig. 16.

Cymbella tumida (Breb.) Van Heurck var. *borealis* Grun., SKVORTZOW, Diatoms of Hanka Lake (1929) pl. 7, fig. 3.

Valve cymbiform and truncate. Length, 0.085 mm; breadth, 0.017. Striæ 8 in 0.01 mm. Common in fresh water.

CYMBELLA KAWAMURÆ sp. nov. Plate 15, fig. 10.

Valve naviculiform, lanceolate, with attenuate and capitate ends. Striæ strong, radiate, not striate, in the middle of unequal length, 12 in 0.01 mm. Axial area very narrow, central elliptical with two isolated puncta. Length, 0.027 mm; breadth, 0.009. A distinct species, named in honor of Prof. Dr. T. Kawamura, of Kyoto, Nippon.

GOMPHONEMA VASTUM Hustedt. Plate 13, fig. 5.

Gomphonema vastum HUSTEDT, Bacillar. a. d. Aokikosee in Japan 166, pl. 5, fig. 4.

Valve clavate with slightly capitate apex and narrow base. Length, 0.028 mm; breadth, 0.006. Striæ short, marginal, 12 in 0.01 mm. Axial area broad. Central area with one isolated punctum. Reported only from Aokiko Lake, Nippon.

GOMPHONEMA VASTUM Hustedt var. CUNEATA var. nov. Plate 10, fig. 11.

Valve with cuneate apex. Length, 0.039 mm; breadth, 0.005. Striæ 15 in 0.01 mm.

GOMPHONEMA VASTUM Hustedt var. ELONGATA var. nov. Plate 13, figs. 33 and 40.

Valve with elongate apex. Length, 0.028 to 0.034 mm; breadth, 0.005 to 0.006. Striæ 12 to 17 in 0.01 mm. Common in Kizaki Lake.

GOMPHONEMA ACUMINATUM Ehr. Plate 13, fig. 38.

Gomphonema acuminatum Ehr., FR. HUSTEDT, Bacillar. (1930) 370, fig. 683.

Valve clavate and biconstricted. Striæ 10 to 11 in 0.01 mm. Length, 0.034 mm; breadth, 0.085. Common in fresh water.

GOMPHONEMA ACUMINATUM Ehr. var. TURRIS (Ehr.) Cleve. Plate 12, fig. 4.

Gomphonema acuminatum Ehr. var. *turris* (Ehr.) Cleve, A. SCHMIDT, Atlas Diatom. (1902) pl. 239, figs. 34–36.

Valve slightly biconstricted. Striæ 16 to 18 in 0.01 mm. Length, 0.047 mm; breadth, 0.085. Common in fresh water. Rare in Kizaki Lake.

GOMPHONEMA ACUMINATUM Ehr. var. CORONATA (Ehr.) W. Smith. Plate 13, fig. 8.

Gomphonema acuminatum Ehr. var. *coronata* (Ehr.) W. Smith, FR. HUSTEDT, Bacillar. (1930) 370, fig. 684.

Valve slightly biconstricted, elongate. Length, 0.069 mm; breadth, 0.01. Rare in Kizaki Lake.

GOMPHONEMA PARVULUM (Kütz.) Grun. Plate 13, figs. 16 and 34.

Gomphonema parvulum (Kütz.) Grun., A. SCHMIDT, Atlas Diatom. (1902) pl. 234, fig. 14.

Valve elliptic-clavate with capitate ends. Length, 0.02 mm; breadth, 0.0065. Striæ 14 to 15 in 0.01 mm. Common in fresh water.

GOMPHONEMA PARVULUM (Kütz.) Grun. var. EXILISSIMA Grun. Plate 13, fig. 21.

Gomphonema parvulum (Kütz.) Grun. var. *exilissima* Grun., VAN HEURCK, Synopsis (1880–1881) pl. 25, fig. 12.

Valve narrow, lanceolate. Length, 0.017 mm; breadth, 0.0042. Striæ 15 in 0.01 mm. Uncommon.

GOMPHONEMA PARVULUM (Kütz.) Grun. var. MICROPUS (Kütz.) Cleve. Plate 13, fig. 9.

Gomphonema parvulum (Kütz.) Grun. var. *micropus* (Kütz.) Cleve, FR. HUSTEDT, Bacillar. (1930) 373, fig. 713c.

Valve slightly clavate with obtuse apex. Length, 0.011 mm; breadth, 0.005. Striæ 15 in 0.01 mm.

GOMPHONEMA PARVULUM (Kütz.) Grun. var. MICROPUS (Kütz.) Cleve fo. NIPPONICA fo. nov. Plate 13, fig. 36.

Valve minute, subovate with obtuse apex. Length, 0.009 mm; breadth, 0.0029. Striæ 18 in 0.01 mm. Isolated puncta indistinct. Differs from variety *micropus* in its closer striæ and smaller size.

GOMPHONEMA LANCEOLATUM Ehr. var. INSIGNIS (Greg.) Cleve. Plate 12, fig. 7; Plate 13, fig. 32.

Gomphonema lanceolatum Ehr. var. *insignis* (Greg.) Cleve, FR. HUSTEDT, Bacillar. (1930) 376, fig. 701.

Valve lanceolate, clavate, apex acuminate, slightly cuneate. Length, 0.04 to 0.06 mm; breadth, 0.0085 to 0.015. Striæ 8 to 9 in 0.01 mm. Common in fresh water.

GOMPHONEMA AUGUR Ehr. Plate 13, fig. 31.

Gomphonema augur Ehr., FR. HUSTEDT, Bacillar. (1930) 372, fig. 688.

Valve clavate with broad, truncate-apiculate apex. Length, 0.051 mm; breadth, 0.02. Striæ 10 in 0.01 mm. Uncommon in Kizaki Lake.

GOMPHONEMA AUGUR Ehr. var. GAUTIERI Van Heurck.

Gomphonema augur Ehr. var. *Gautieri* Van Heurck, FR. HUSTEDT, Bacillar. (1930) 372, fig. 689.

Like the type, but with longer valve. Length, 0.051 mm; breadth, 0.01. Common in Kizaki Lake.

GOMPHONEMA QUADRIPUNCTATUM (Oestr.) Wislouch var. HASTATA Wislouch. Plate 10, fig. 31.

Gomphonema quadripunctatus (Oestr.) Wislouch var. *hastata* WISLOUCH, Neue Untersuchungen über d. Diatomeen des Baikal-Sees (1924) 166–167, figs. a–c.

Valve clavate with attenuate and broad apex. Length, 0.044 mm; breadth, 0.009. Striæ radiate, 11 to 13 in 0.01 mm. Central area a broad fascia with four isolated puncta. Median line straight, with long terminal fissures. Rare. Reported from northern Europe, Baikal Lake, Manchurian Mongolia.

GOMPHONEMA SUBTILE Ehr. var. SAGITTA Schumann. Plate 10, fig. 19.

Gomphonema subtile Ehr. var. *sagitta* Schumann, A. SCHMIDT, Atlas Diatom. (1903) pl. 236, fig. 13.

Valve clavate with slightly capitate apex and narrow base. Length, 0.028 mm; breadth, 0.0034. Striæ 11 in 0.01 mm. Axial area linear. Known from Europe.

GOMPHONEMA LINGULATUM Hustedt. Plate 13, figs. 6 and 7.

Gomphonema lingulatum HUSTEDT, Bacillar. a. d. Aokikosee in Japan 166–167, pl. 5, fig. 5.

Valve clavate with broad, truncate, apiculate apex and narrow base. Length, 0.023 to 0.03 mm; breadth, 0.0068 to 0.008. Striæ marginal, 15 in 0.01 mm. No isolated punctum. Known only from Aokiko Lake, Nippon.

GOMPHONEMA OLIVACEUM (Lyngb.) Kütz. Plate 13, fig. 22.

Gomphonema olivaceum (Lyngb.) Kütz., FR. HUSTEDT, Bacillar. (1930) 378, fig. 719.

Valve subclavate with broad, obtuse apex. Length, 0.024 mm; breadth, 0.006. Striæ 15 in 0.01 mm. Common in fresh water.

GOMPHONEMA OLIVACEUM (Lyngb.) Kütz. var. MINUTISSIMA Hustedt. Plate 13, fig. 39.

Gomphonema olivaceum (Lyngb.) Kütz. var. *minutissima* HUSTEDT, Bacillar. (1930) 378–379, fig. 720.

Like the type, but smaller. Length, 0.01 mm; breadth, 0.004. Striæ 15 in 0.01 mm. Uncommon.

GOMPHONEMA GRACILE Ehr. var. LANCEOLATA (Kütz.) Cleve. Plate 10, fig. 8.

Gomphonema gracile Ehr. var. *lanceolata* (Kütz.) Cleve, A. SCHMIDT, Atlas Diatom. (1903) pl. 236, figs. 26–28.

Valve lanceolate-clavate, with apiculate apex. Length, 0.035 mm; breadth, 0.0065. Striæ 15 in 0.01 mm. In fresh water, common in the Tropics.

GOMPHONEMA ABBREVIATUM Agardh? Kütz. Plate 13, fig. 42.

Gomphonema abbreviatum Agardh? Kütz., FR. HUSTEDT, Bacillar. (1930) 379, fig. 722.

Valve clavate with broad ends. Length, 0.017 mm; breadth, 0.0034. Striæ marginal, 15 in 0.01 mm. Axial and central areas uniting in a broad linear-lanceolate space. Reported from fresh and brackish waters.

GOMPHONEMA INTRICATUM Kütz. Plate 13, figs. 14 and 41.

Gomphonema intricatum Kütz., A. SCHMIDT, Atlas Diatom. (1903) pl. 235, figs. 16–17.

Valve sublinear, slightly gibbous in the middle with obtuse apex and base. Length, 0.035 to 0.044 mm; breadth, 0.0056 to 0.0085. Striæ 12 in 0.01 mm. Common in fresh water.

GOMPHONEMA CONSTRICTUM Ehr. Plate 13, figs. 13 and 20.

Gomphonema constrictum Ehr., FR. HUSTEDT, Bacillar. (1930) 377, fig. 714.

Valve clavate, biconstricted with rounded, truncate apex. Length, 0.039 to 0.044 mm; breadth, 0.01 to 0.014. Striæ 9 to 10 in 0.01 mm. Common in fresh water.

GOMPHONEMA CONSTRICTUM Ehr. var. CAPITATA (Ehr.) Cleve. Plate 13, fig. 23.

Gomphonema constrictum Ehr. var. *capitata* (Ehr.) Cleve, FR. HUSTEDT, Bacillar. (1930) 377, fig. 715.

Valve clavate with broad, truncate ends. Length, 0.03 to 0.039 mm; breadth, 0.006 to 0.0085. Striæ 12 in 0.01 mm. Common in Kizaki Lake.

GOMPHONEMA BERGGRENII Cleve. Plate 12, fig. 16.

Gomphonema Berggrenii CLEVE, Synopsis Navicul. Diatoms (1894) I, 185, pl. 5, figs. 6, 7; A. SCHMIDT, Atlas Diatom. (1903) pl. 240, figs. 26–30.

Valve clavate with broad subtruncate apex. Base elongate, narrow. Length, 0.044 mm; breadth, 0.0085. Axial area with an isolated punctum. The median stria opposite to the isolated punctum is shortened. Only known from fresh water in New Zealand.

GOMPHONEMA NIPPONICA sp. nov. Plate 12, fig. 3; Plate 13, fig. 24.

Valve elongate, clavate with subtruncate and constricted apex. Ends long, attenuate, obtuse. Length, 0.056 to 0.06 mm; breadth, 0.0085 to 0.01. Striæ robust, 9 in 0.01 mm. Axial area narrow, narrowed to the middle, unilateral. Central area unilateral, opposite to the stigma a broad stauros. Not common in Kizaki Lake. *Gomphonema bohemicum* Reichelt and Fricke and *G. dubia* Meister are nearly related to this new species.

EPITHEMIA CISTULA (Ehr.) var. LUNARIS Grun. Plate 9, fig. 12.

Epithemia cistula (Ehr.) var. *lunaris* GRUNOW, Beiträge zur Kenntniss der fossilen Diatomeen Osterreich-Ungarns (1903) 137–138, pl. 29, figs. 1, 2.

Epithemia hyndmannii W. Smith var. *chinensis* SKVORTZOW, Alpine Diatoms from South China (1929) 46, pl. 2, figs. 22, 23; pl. 3, fig. 9.

Valve lunate, gibbous on the dorsal side. Ends long, obtuse. Length, 0.057 to 0.06 mm; breadth, 0.011 to 0.014. Costæ 3, striæ 15, in 0.01 mm. Reported from fresh water in Bengal, India, from Foochow, southern China, and as a fossil from Dubravica, Hungary.

EPITHEMIA ZEBRA (Ehr.) Kütz.

Epithemia zebra (Ehr.) Kütz., FR. HUSTEDT, Bacillar. (1930) 384–385, fig. 729.

Valve linear with straight ventral side. Length, 0.085 mm; breadth, 0.01. Costæ 4, striæ 15, in 0.01 mm. Known from Aokiko Lake.

EPITHEMIA ZEBRA (Ehr.) Kütz. var. SAXONICA (Kütz.) Grun. Plate 10, fig. 21.

Epithemia zebra (Ehr.) Kütz. var. *saxonica* (Kütz.) Grun., FR. HUSTEDT, Bacillar. (1930) 385, fig. 730.

Valve linear, curved. The obtuse ends are slightly turned downwards. Length, 0.034 mm; breadth, 0.01. Striæ 13 to 14 in 0.01 mm. Not common in Kizaki Lake.

EPITHEMIA SOREX Kütz. Plate 15, fig. 12.

Epithemia sorex Kütz., FR. HUSTEDT, Bacillar. (1930) 388, fig. 736.

Valve broad, gibbous on the dorsal side, slightly curved on the ventral side. Length, 0.025 mm; breadth, 0.008. Common in fresh and brackish waters. Reported from Aokiko Lake, Nippon.

RHOPALODIA GIBBA (Ehr.) O. Mull. Plate 9, fig. 2.

Rhopalodia gibba (Ehr.) O. Mull., FR. HUSTEDT, Bacillar. (1930) 390, fig. 740.

Valve linear, arcuate, straight on the ventral side, reflexed at the extremities. Costæ 6 in 0.01 mm. Length, 0.111 mm; breadth, 0.0085. Common in Kizaki Lake.

RHOPALODIA GIBBERULA (Ehr.) O. Mull. Plate 8, fig. 12.

Rhopalodia gibberula (Ehr.) O. Mull., FR. HUSTEDT, Bacillar. (1930) 391, fig. 742.

Valve gibbous in the middle of the dorsal side and straight on ventral side. Length, 0.045 mm; breadth, 0.022. A species of brackish waters. Not common in Kizaki Lake.

RHOPALODIA PARALLELA (Grun.) O. Mull. Plate 8, fig. 7; Plate 9, fig. 11.

Rhopalodia parallela (Grun.) O. Mull., FR. HUSTEDT, Bacillar. (1930) 389–390, fig. 739.

Valve linear with parallel margins. Length, 0.062 to 0.2 mm; breadth, 0.018 to 0.03. Costæ 5 to 6 in 0.01 mm. Striæ 16 in 0.01 mm. An alpine species, known from many parts of the world.

NITZSCHIA FONTICOLA Grun. Plate 13, fig. 35.

Nitzschia fonticola Grun., FR. HUSTEDT, Bacillar. (1930) 415, fig. 800.

Valve lanceolate with obtuse ends. Length, 0.01 mm; breadth, 0.0034. Costæ 12, striæ 24, in 0.01 mm. Not common in Kizaki Lake.

NITZSCHIA SIGMOIDEA (Ehr.) W. Smith. Plate 10, fig. 2.

Nitzschia sigmoidea (Ehr.) W. Smith, FR. HUSTEDT, Bacillar. (1930) 419, fig. 810.

Valve sigmoid with parallel margins. Length, 0.34 to 0.38 mm; breadth, 0.01. This is the largest *Nitzschia* species in Kizaki Lake. Known from Aokiko Lake.

NITZSCHIA INTERRUPTA (Reichelt) Hustedt. Plate 13, fig. 1.

Nitzschia moissacensis var. *Heideni* MEISTER, in Beiträge zur Bacillar. Japans (1914) 229, pl. 8, fig. 10.

Nitzschia (*moissacensis* Herib. var.?) *Heideni* Meister, A. SCHMIDT, Atlas Diatom. (1924) pl. 351, figs. 9–13.

Nitzschia denticula GRUN., Diatom. Vega-Exped. (1883) 492, pl. 37, fig. 68.

Denticula interrupta Reichelt, KUNZE, Revisio 3, 392, fig.

Valve lanceolate with attenuate and slightly capitate ends. Costæ long, irregularly disposed, 5 in 0.01 mm. Striæ robust, elongate, 14 to 15 in 0.01 mm. Length, 0.03 to 0.035 mm; breadth, 0.0068 to 0.007. Common in Kizaki Lake. Reported from Aokiko Lake.

NITZSCHIA PALEA (Kütz.) W. Smith. Plate 13, figs. 19 and 28.

Nitzschia palea (Kütz.) W. Smith, FR. HUSTEDT, Bacillar. (1930) 416, fig. 801.

Valve linear-lanceolate with attenuate ends. Length, 0.029 to 0.032 mm; breadth, 0.0025 to 0.0042. Costæ 11 to 12 in 0.01 mm. Striæ very fine, about 35 in 0.01 mm. Common in Kizaki Lake.

NITZSCHIA PALEA (Kütz.) W. Smith var. TENUIROSTRIS Grun. Plate 13, fig. 2.

Nitzschia palea (Kütz.) W. Smith var. *tenuirostris* Grun., SKVORTZOW, Diatom recoltees par le Pere E. Licent (1935) 43, pl. 9, fig. 40.

Valve linear-lanceolate, slightly constricted in the middle part. Ends slightly capitate. Length, 0.037 mm; breadth, 0.0042. Costæ 10 to 11 in 0.01 mm. Striæ 35 in 0.01 mm. Not common.

NITZSCHIA DISSIPATA (Kütz.) Grun. Plate 13, figs. 17, 18, and 26.

Nitzschia dissipata (Kütz.) Grun., A. SCHMIDT, Atlas Diatom. (1921) pl. 332, fig. 23.

Valve linear-lanceolate with attenuate ends. Length, 0.02 to 0.057 mm; breadth, 0.0034 to 0.051. Costæ 7 in 0.01 mm. Striæ very fine, indistinct. Common in Kizaki Lake.

NITZSCHIA RECTA Hantzsch. Plate 13, fig. 25.

Nitzschia recta Hantzsch, FR. HUSTEDT, Bacillar. (1930) 411, fig. 785.

Valve linear with truncate, obtuse ends. Length, 0.093 to 0.098 mm; breadth, 0.005 to 0.006. Costæ 5 to 6 in 0.01 mm. Striæ indistinct. Common in fresh water.

NITZSCHIA COMMUNIS Rabenh. Plate 13, fig. 15.

Nitzschia communis Rabenh., FR. HUSTEDT, Bacillar. (1930) 417, fig. 798.

Valve broad-lanceolate with obtuse ends. Length, 0.014 mm; breadth, 0.0034. Costæ 12 in 0.01 mm. Striæ very indistinct. Common in fresh water.

NITZSCHIA CAPITELLATA Hustedt var. **NIPPONICA** var. nov. Plate 13, fig. 30.

Valve linear-lanceolate, constricted and rostrate-capitate. Length, 0.072 mm; breadth, 0.005. Costæ 7, striæ 30, in 0.01 mm. Differs from the type in its constricted valve and the different number of costæ.

NITZSCHIA VITREA Norman? Plate 13, fig. 29.

Nitzschia vitrea Norman, A. SCHMIDT, Atlas Diatom. (1921) pl. 334, figs. 16, 17.

Valve lanceolate, attenuate, and subrostrate. Length, 0.045 mm; breadth, 0.006. Costæ long, 8 in 0.01 mm. Striæ 18 in 0.01 mm. The Nippon form differs from the type in its short valve. A fresh-water species.

NITZSCHIA ACICULARIS W. Smith var. **NIPPONICA** var. nov. Plate 13, fig. 27.

Valve lanceolate with long horns or beaks. Length, 0.054 to 0.068 mm; breadth, 0.002 to 0.0025. Valve hyaline without striæ. Common in Kizaki Lake.

HANTZSCHIA AMPHIOXYS (Ehr.) Grun. Plate 13, fig. 11.

Hantzschia amphioxys (Ehr.) Grun., FR. HUSTEDT, Bacillar. (1930) 394, fig. 747.

Valve lanceolate, constricted at one side, convex from the other. Ends truncate, slightly curved. Length, 0.032 mm; breadth, 0.006. Costæ 8 to 9, striæ 18, in 0.01 mm. Common in Kizaki Lake.

HANTZSCHIA ELONGATA (Hantz.) Grun. Plate 8, fig. 3.

Hantzschia elongata (Hantz.) Grun., FR. HUSTEDT, Bacillar. (1930) 395, fig. 751.

Valve linear-lanceolate, attenuate towards the ends. Length, 0.195 mm; breadth, 0.01. Costæ 5, striæ 15, in 0.01 mm. Not common in Kizaki Lake.

CYMATOPLEURA SOLEA (Breb.) W. Smith var. **GRACILIS** Grun. Plate 15, fig. 6.

Cymatopleura solea (Breb.) W. Smith var. *gracilis* Grun., FR. HUSTEDT, Bacillar. (1930) 423.

Valve linear, constricted in the middle, panduriform, cuneate at both ends. Length, 0.127 to 0.13 mm; breadth, 0.018 to 0.019. Reported from Aokiko Lake, Nippon.

CYMATOPLEURA SOLEA (Breb.) W. Smith var. REGULA (Ehr.) Grun. Plate 15, fig. 7.

Cymatopleura solea (Breb.) W. Smith var. *regula* (Ehr.) Grun., FR. HUSTEDT, Bacillar. (1930) 426, fig. 823b.

Valve linear, not constricted. Length, 0.062 mm; breadth, 0.001. Rare.

CYMATOPLEURA ELLIPTICA (Breb.) W. Smith. Plate 14, fig. 1.

Cymatopleura elliptica (Breb.) W. Smith, FR. HUSTEDT, Bacillar. (1930) 426, fig. 825.

Valve broad-elliptic, cuneate. Length, 0.111 to 0.15 mm; breadth, 0.05 to 0.052. Common in Kizaki Lake.

SURIRELLA BISERIATA Breb. Plate 14, fig. 12.

Surirella biseriata Breb., FR. HUSTEDT, Bacillar. (1930) 432, fig. 831.

Valve lanceolate with acute ends. Costæ reaching the median line, 2 in 0.01 mm. Long diameter, 0.142 mm; short diameter, 0.024. Common. Known from Aokiko Lake.

SURIRELLA BISERIATA Breb. fo. PUNCTATA Meister.

Surirella biseriata Breb. fo. *punctata* Meister, FR. HUSTEDT, Bacillar. (1930) 433.

A form covered with puncta. Long diameter, 0.17 mm; short diameter, 0.032. Costæ 2 in 0.01 mm. Not common. Reported from Europe.

SURIRELLA BISERIATA Breb. var. NIPPONICA var. nov. Plate 14, fig. 11.

Valve elongate-lanceolate with acute ends. Costæ 2 to 3 in 0.01 mm. Long diameter, 0.2 to 0.23 mm; short diameter, 0.028 to 0.03. Differs from the type in its longer valve. *Surirella Engleri* O. Mull. var. *hankensis* Skvortzow [2] seems to be related to the above species. Common in Kizaki Lake.

SURIRELLA BISERIATA Breb. var. NIPPONICA fo. PUNCTATA fo. nov. Plate 15, fig. 3.

Valve punctate. Long diameter, 0.25 mm; short diameter, 0.027. Costæ 2 in 0.01 mm. Not common.

SURIRELLA BISERIATA Breb. var. CONSTRICTA Grun. fo. PUNCTATA fo. nov. Plate 14, fig. 14.

Valve constricted, acute and punctate. Median line linear. Long diameter, 0.12 mm; short diameter, 0.022. Known from Europe.

[2] Diatoms of Hanka Lake (1929) 37, pl. 8, fig. 3.

SURIRELLA BISERIATA Breb. var. BIFRONS (Ehr.) Hustedt fo. HISPIDA fo. nov. Plate 15, fig. 1.

Valve short-elliptic with acute ends, irregularly covered with horns. Long diameter, 0.102 mm; short diameter, 0.047. The variety *bifrons* was reported from Aokiko Lake.

SURIRELLA ROBUSTA Ehr. fo. LATA Hustedt. Plate 16, fig. 10.

Surirella robusta Ehr. fo. *lata* HUSTEDT, Bacillar. aus dem Aokikosee in Japan 170, fig. 1.

Valve ovate with one end much broader than the other. Costæ short, 1.5 to 2 in 0.01 mm, not reaching the pseudoraphe. Marginal keel forming wings in the middle part of the costæ. Pseudoraphe lanceolate. Polar areas large. Long diameter, 0.072 mm; short diameter, 0.03. Reported only from Nippon. Common in Kizaki Lake.

SURIRELLA ROBUSTA Ehr. var. SPLENDIDA (Ehr.) Van Heurck. Plate 14, fig. 3.

Surirella robusta Ehr. var. *splendida* (Ehr.) Van Heurck, FR. HUSTEDT, Bacillar. (1930) 437, figs. 851–852.

Valve narrow ovate, rounded at one end and acute at the other. Costæ not reaching the median area. Long diameter, 0.093 to 0.136 mm; short diameter, 0.025 to 0.047. Common. Reported from Aokiko Lake.

SURIRELLA ROBUSTA Ehr. var. SPLENDIDA (Ehr.) Van Heurck fo. HUSTEDTIANA (Mayer) Hustedt.

Surirella robusta Ehr. var. *splendida* (Ehr.) Van Heurck fo. *Hustedtiana* (Mayer) HUSTEDT, Bacillar. (1930) 438.

Valve elliptic-lanceolate with acute ends. Costæ not reaching the median area, parallel in the middle, radiate at the ends. Long diameter, 0.115 mm; short diameter, 0.037. Costæ 2 in 0.01 mm. Known from Europe.

SURIRELLA ROBUSTA Ehr. var. SPLENDIDA (Ehr.) Van Heurck fo. PUNCTATA Hustedt. Plate 16, fig. 2.

Surirella robusta Ehr. var. *splendida* (Ehr.) Van Heurck fo. *punctata* HUSTEDT, Bacillar. (1930) 437.

Valve with attenuate, rounded ends. Punctate between the costæ. Long diameter, 0.111 mm; short diameter, 0.037. Costæ 1 to 1.5 in 0.01 mm. Known from Europe.

SURIRELLA ROBUSTA Ehr. var. SPLENDIDA (Ehr.) Van Heurck fo. CONSTRICTA Hustedt. Plate 16, fig. 1.

Surirella robusta Ehr. var. *splendida* (Ehr.) Van Heurck fo. *constricta* HUSTEDT, Bacillar. (1930) 437.

Valve constricted. Long diameter, 0.153 mm; short diameter, 0.037. Rare.

SURIRELLA LINEARIS W. Smith. Plate 15, fig. 11.

Surirella linearis W. Smith, FR. HUSTEDT, Bacillar. (1930) 434, fig. 837.

Valve linear with cuneate ends. Alæ and costæ distinct. Median line linear. Long diameter, 0.042 mm; short diameter, 0.01. Costæ 2.5 in 0.01 mm. Reported from Aokiko Lake.

SURIRELLA LINEARIS W. Smith var. CONSTRICTA (Ehr.) Grun. Plate 14, fig. 7.

Surirella linearis W. Smith var. *constricta* (Ehr.) Grun., FR. HUSTEDT, Bacillar. (1930) 434, fig. 839.

Valve constricted. Long diameter, 0.072 mm; short diameter, 0.013. Costæ 2 in 0.01 mm. Found in Aokiko Lake, Nippon.

SURIRELLA LINEARIS W. Smith var. HELVETICA (Brun) Meister. Plate 16, fig. 8.

Surirella linearis W. Smith var. *helvetica* (Brun) Meister, FR. HUSTEDT, Bacillar. (1930) 434, fig. 840.

Valve linear with parallel margins, cuneate and punctate. Long diameter, 0.119 mm; short diameter, 0.034. Costæ 1.5 in 0.01 mm. Also reported from Aokiko Lake, Nippon.

SURIRELLA LINEARIS W. Smith var. NIPPONICA var. nov. Plate 15, fig. 9.

Valve linear with subcuneate ends, punctate. Outer rim robust. Marginal keel or alæ distinct. Costæ parallel, 2.5 to 3 in 0.01 mm. Median line linear. Long diameter, 0.052 mm; short diameter, 0.014. Variety *nipponica* is closely connected with variety *helvetica*.

SURIRELLA LINEARIS W. Smith var. NIPPONICA fo. CONSTRICTA fo. nov. Plate 15, fig. 8.

Valve constricted with attenuate and cuneate ends, punctate. Median line linear. Long diameter, 0.064 mm; short diameter, 0.01 to 0.012. Costæ 3 in 0.01 mm. Not common.

SURIRELLA LINEARIS W. Smith var. APICULATA var. nov. Plate 16, fig. 3.

Valve linear, slightly constricted with subrostrate ends. Costæ parallel, 3 in 0.01 mm, reaching the median line. Long diameter, 0.076 mm; short diameter, 0.014.

SURIRELLA CAPRONII Breb. var. OBTUSA Hustedt. Plate 14, fig. 5.

Surirella Capronii Breb. var. *obtusa* HUSTEDT, Bacillar. a. d. Aokikosee in Japan 170, fig. 2.

Valve elongate-ovate with one end much broader than the other. Ends obtuse. Outer rim robust. Area distinct and robust. Costæ not reaching the median area. On both ends of the median area two opposite horns. Polar area distinct. Long diameter, 0.136 mm; short diameter, 0.047. Known only from Aokiko and Kizaki Lakes.

SURIRELLA CAPRONII Breb. var. OBTUSA Hustedt fo. CAPITATA fo. nov. Plate 16, fig. 4.

Valve slightly constricted, one end very broad. Alæ and costæ robust, 1 in 0.01 mm. Long diameter, 0.156 mm; short diameter, 0.051.

SURIRELLA ELEGANS Ehr. fo. ELONGATA fo. nov. Plate 15, fig. 4.

Valve linear with one end much broader than the other. Costæ parallel, radiate at the ends, not reaching the median line. Long diameter, 0.215 mm; short diameter, 0.044. Costæ 2 in 0.01 mm. Differs from the type in its more elongate valves.

SURIRELLA TENERA Gregory. Plate 14, fig. 13.

Surirella tenera Gregory, FR. HUSTEDT, Bacillar. (1930) 438, fig. 853.

Valve elongate-ovate, rounded at one end and acute at the other. Outer rim narrow, smooth. Marginal alæ distinct. Costæ reaching the pseudoraphe, parallel in the middle, radiate at the ends. Long diameter, 0.138 to 0.14 mm; short diameter, 0.035. Common in fresh water. Not common in Kizaki Lake.

SURIRELLA TENERA Gregory var. PUNCTATA var. nov. Plate 12, fig. 14.

Punctate between the costæ. Long diameter, 0.136 mm; short diameter, 0.04. Uncommon.

SURIRELLA TENERA Gregory var. NERVOSA A. Schmidt. Plate 14, fig. 15.

Surirella tenera Gregory var. *nervosa* A. Schmidt, FR. HUSTEDT, Bacillar. (1930) 439, figs. 854–855.

Differs from the type in the median line being ornamented with a horn. Long diameter, 0.114 mm; short diameter, 0.034. Costæ 2 in 0.01 mm. Uncommon.

SURIRELLA TERRYANA Ward. Plate 16, fig. 11.

Surirella Terryana Ward, A. SCHMIDT, Atlas Diatom. (1912) pl. 280, figs. 7–8.

Valve linear with obtuse ends, margins parallel or slightly constricted in the middle. Outer rim narrow, finely crossbarred.

Costæ or ribs reaching the pseudoraphe, 3 in 0.01 mm, parallel in the middle, slightly radiate at the ends. Between the costæ are fine, closely set, parallel lines. Common in Kizaki and Aokiko Lakes. Known from North and South America only. *Surirella Chachinæ* Skvortzow [3] is closely connected with *Surirella Terryana.*

SURIRELLA TERRYANA Ward fo. MINUTA fo. nov. Plate 10, fig. 24; Plate 15, fig. 13.

Valve linear with parallel margins or slightly constricted, with rounded or cuneate ends. Costæ not reaching the pseudoraphe, 3 in 0.01 mm. Central area linear, extending the length of the valve. Long diameter, 0.037 to 0.04 mm; short diameter, 0.008 to 0.009. Striæ indistinct. Common.

SURIRELLA TERRYANA Ward var. NIPPONICA var. nov. Plate 15, fig. 2.

Valve linear, constricted, with cuneate long ends. Outer rim narrow, finely crossbarred. Costæ or ribs 2 in 0.01 mm, slightly curved, reaching the pseudoraphe. Striæ distinct. Long diameter, 0.124 to 0.13 mm; short diameter, in the middle part 0.014, at the ends 0.019. Uncommon.

SURIRELLA OVALIS Breb. var. NIPPONICA var. nov. Plate 13, fig. 4.

Valve ovate with outer rim robust, crossbarred. Costæ short, 2 in 0.01 mm, not reaching the median area. Between the costæ are fine, closely set, parallel lines. Median area is bounded by a closely set row of transverse lines, 18 in 0.01 mm. Long diameter, 0.098 mm; short diameter, 0.042. Variety *nipponica* differs from the type in its set row of transverse lines around the median area. *Surirella ovalis* is known as a brackish-water diatom.

SURIRELLA ANGUSTATA Kütz. Plate 3, fig. 15.

Surirella angustata Kütz., FR. HUSTEDT, Bacillar. (1930) 435, figs. 844–845.

A minute species common in fresh water. Valve linear with cuneate ends. Costæ reaching the pseudoraphe, about 6 in 0.01 mm, parallel in the middle, radiate at the ends. Long diameter, 0.034 mm; short diameter, 0.011.

SURIRELLA PANTOCSEKII Meister. Plate 6, fig. 6.

Surirella Pantocsekii MEISTER, Beiträge zur Bacillar. Japans (1914) 230, pl. 8, figs. 14, 15.

Valve long-linear with panduriform rounded ends. Outer rim narrow, finely crossbarred. Costæ thin, short, parallel in the

[3] Diatoms from Hanka Lake (1929) 40, pl. 8, fig. 20.

middle, radiate at the ends with intercostal striæ. Central area narrow. Long diameter, 0.102 to 0.108 mm; short diameter, in the middle part 0.01, at the ends 0.013. Five fine costæ in 0.01 mm. Reported as occurring near Yokohama, Nippon. Known from Amur and Sungari Rivers, Manchuria. *Surirella tiensinensis* Skvortzow, from Tientsin, northern China, and from Hanka Lake, Siberia, differs from *S. Pantocsekii* only in its obtuse ends and smaller size.

SURIRELLA NIPPONICA sp. nov. Plate 8, fig. 17.

Valve lanceolate with attenuate ends. Costæ short, radiate, about 2 in 0.01 mm. Striæ distinct. Median area broad. Differs from *Surirella delicatissima* Lewis [4] in its broader valve and wider costæ.

STENOPTERОBIA INTERMEDIA (Lewis) fo. SUBACUTA Fricke. Plate 10, fig. 30.

Stenopterobia intermedia (Lewis) fo. *subacuta* Fricke, A. SCHMIDT, Atlas Diatom. (1912) pl. 284, fig. 6.

Valve sigmoid with inconspicuous alæ. Length, 0.119 mm; breadth, 0.004. Striæ 30 in 0.01 mm. Very rare. Known from Aokiko Lake (variety *capitata* Fontell.).

[4] A. Schmidt, Atlas Diatom. (1906) pl. 266, fig. 6.

ILLUSTRATIONS

PLATE 1

FIG. 1. *Melosira americana* Kütz.
2. *Melosira undulata* (Ehr.) Kütz. var. *Normanni* Arnott.
FIGS. 3 and 4. *Melosira Binderana* Kütz.
FIG. 5. *Melosira italica* (Ehr.) Kütz. subsp. *subarctica* O. Mull.
6. *Melosira italica* (Ehr.) Kütz. var. *tenuissima* (Grun.) O. Mull.
7. *Melosira italica* (Ehr.) Kütz. var. *valida* Grun.
8. *Melosira granulata* (Ehr.) Ralfs.
9. *Fragilaria pinnata* Ehr.
10. *Melosira distans* (Ehr.) Kütz.
11. *Cyclotella stelligera* Cleve and Grun.
12. *Cyclotella glomerata* Bachmann fo. *nipponica* fo. nov.
13. *Diatoma hiemale* (Lyngb.) Heiberg. var. *mesodon* (Ehr.) Grun.
14. *Synedra Vaucheriæ* Kütz.
15. *Synedra Vaucheriæ* Kütz. var. *capitellata* Grun.
16. *Tabellaria flocculosa* (Roth.) Kütz.
17. *Fragilaria construens* (Ehr.) Grun. var. *binodis* (Ehr.) Grun.
18. *Fragilaria brevistriata* Grun. var. *inflata* (Pant.) Hust. fo. *curta* fo. nov.
19. *Meridion circulare* Agardh.
20. *Synedra rumpens* Kütz. var. *nipponica* var. nov.
21. *Fragilaria capucina* Desm.
22. *Synedra parasitica* (W. Smith).
23. *Fragilaria gracillima* Mayer.
24. *Diatoma hiemale* (Lyngb.) Heiberg.
25. *Eunotia paludosa* Grun.
26. *Fragilaria crotonensis* Kitton.
27. *Synedra japonica* Meister.
FIGS. 28 and 29. *Fragilaria construens* (Ehr.) Grun.
FIG. 30. *Eunotia pectinalis* (Kütz.) Rabh. var. *minor* (Kütz.) Rabh.
31. *Eunotia veneris* (Kütz.) O. Mull. var. *nipponica* var. nov.
32. *Eunotia pectinalis* (Kütz.) Rabh. var. *nipponica* var. nov.
FIGS. 33 and 34. *Asterionella gracillima* (Hantzsch) Heiberg.
FIG. 35. *Tabellaria fenestrata* (Lyngb.) Kütz.
36. *Synedra Ulna* (Nitzsch) Ehr.
37. *Synedra Ulna* (Nitzsch) Ehr. var. *Ramesi* (Herib. and Perag.) Hust.
38. *Ceratoneis arcus* Kütz. var. *Hattoriana* Meister.
39. *Synedra Ulna* (Nitzsch) Ehr. var. *biceps* (Kütz.).
40. *Eunotia gracilis* (Ehr.) Rabh.
41. *Eunotia valida* Hust.
42. *Synedra Vaucheriæ* Kütz. var. *sigmoidea* var. nov.
43. *Synedra nipponica* sp. nov.
44. *Eunotia lunaris* (Ehr.) Grun.

PLATE 2

FIG. 1. *Diploneis Smithii* (Breb.) Cleve var. *nipponica* var. nov.
2. *Diploneis puella* (Schum.) Cleve.
3. *Diploneis elliptica* (Kütz.) Cleve var. *ladogensis* Cleve.
4. *Diploneis oculata* (Breb.) Cleve.
5. *Cocconeis placentula* (Ehr.) var. *lineata* (Ehr.) Cleve.
6. *Diploneis elliptica* (Kütz.) Cleve var. *ladogensis* Cleve.
7. *Navicula confervacea* Kütz. fo. *nipponica* fo. nov.
8. *Cocconeis placentula* (Ehr.) var. *klinoraphis* Geitler fo. *nipponica* fo. nov.
9. *Diploneis Smithii* (Breb.) Cleve var. *nipponica* var. nov.
10. *Achnanthes Peragalli* Brun and Herib. var. *nipponica* var. nov.

FIGS. 11 and 12. *Achnanthes lanceolata* Breb.

FIG. 13. *Navicula atomarius* sp. nov.
14. *Achnanthes Peragalli* Brun and Herib. var. *nipponica* var. nov.
15. *Achnanthes minutissima* Kütz.

FIGS. 16 to 18. *Cocconeis diminuta* Pant.?

FIG. 19. *Achnanthes pinnata* Hust. var. *nipponica* var. nov.
20. *Achnanthes lanceolata* Breb. var. *rostrata* Hust.
21. *Achnanthes minutissima* Kütz. var. *cryptocephala* Grun.
22. *Achnanthes microcephala* Kütz.
23. *Achnanthes minutissima* Kütz.
24. *Achnanthes Clevei* Grun. var. *nipponica* var. nov.
25. *Achnanthes kisaki* sp. nov.
26. *Diploneis ovalis* (Hilse) Cleve var. *oblongella* (Naegeli) Cleve.
27. *Opephora Martyi* Herib.
28. *Synedra Vaucheriæ* Kütz. var. *capitellata* Grun.
29. *Achnanthes lanceolata* Breb. var. *elliptica* Cleve.
30. *Achnanthes Peragalli* Brun and Herib.

FIGS. 31 and 32. *Achnanthes Oestrupii* (A. Cleve) Hust.

FIG. 33. *Melosira varians* C. A. Ag.
34. *Diatoma hiemale* (Lyngb.) Heiberg.
35. *Navicula Pusio* Cleve var. *arcuata* (Pantocsek) Skvortzow.
36. *Ceratoneis arcus* Kütz. var. *amphioxys* (Rabh.)
37. *Diploneis ovalis* (Hilse) Cleve.
38. *Achnanthes exigua* Grun. var. *indica* Skv.
39. *Eucocconeis flexella* (Kütz.).

PLATE 3

FIG. 1. *Neidium bisulcatum* (Lagerst.) Cleve var. *nipponica* var. nov.
2. *Navicula Brehmi* Hustedt fo. *elongata* fo. nov.
3. *Amphipleura pellucida* Kütz.
4. *Navicula dicephala* (Ehr.) W. Smith.
5. *Cymbella æqualis* W. Smith.
6. *Amphipleura pellucida* Kütz. var. *recta* Kitton.
7. *Gyrosigma Kützingii* (Grun.) Cleve.
8. *Synedra Ulna* (Nitzsch) Ehr.
9. *Caloneis silicula* Ehr. var. *baicalensis* Skv. and Meyer.
10. *Navicula globulifera* Hust. var. *nipponica* var. nov.
11. *Stauroneis Smithii* Grun.

FIG. 12. *Amphora delphinea* (Bailey) A. S. var. *minor* Cleve.
13. *Amphora perpusilla* Grun.
14. *Amphora ovalis* Kütz. var. *pediculus* Kütz.
15. *Surirella angustata* Kütz.
16. *Amphora ovalis* Kütz. fo. *gracilis* (Ehr.) Cleve.
17. *Amphora ovalis* Kütz. var. *libyca* (Ehr.) Cleve.
18. *Amphora Normanii* Rabh.
19. *Pinnularia mesolepta* (Ehr.) W. Smith.
20. *Cymbella cistula* (Hemp.) Grun.
21. *Stauroneis phœnicenteron* Ehr. fo. *nipponica* fo. nov.
22. *Synedra rumpens* Kütz. var. *Meneghiniana* Grun.
23. *Navicula americana* Ehr.

PLATE 4

FIG. 1. *Neidium Hitchcockii* Ehr.
2. *Neidium productum* (W. Smith) Cleve fo. *constricta* Hust.
FIGS. 3 and 4. *Achnanthes gracillima* Hust. var. *nipponica* var. nov.
FIG. 5. *Neidium oblique-striatum* A. S. var. *nipponica* var. nov.
6. *Neidium affine* (Ehr.) Cleve fo. *hercynica* (A. Mayer) Hust.
7. *Navicula Lambda* Cleve var. *densistriata* var. nov.
8. *Neidium bisulcatum* (Lagerst.) Cleve var. *nipponica* var. nov.
9. *Navicula exigua* (Greg.) O. Mull.
10. *Navicula pupula* Kütz. var. *capitata* Hust.
11. *Frustulia vulgaris* Thwaites.
12. *Frustulia rhomboides* (Ehr.) de Toni var. *saxonica* (Rabh.) de Toni fo. *capitata* A. Mayer.
13. *Navicula holophila* (Grun.) Cleve fo. *minor* Kolbe.
14. *Navicula muralis* Grun.
15. *Navicula pseudoscutiformis* Hust.
16. *Neidium oblique-striatum* A. S. var. *rostrata* var. nov.
17. *Caloneis silicula* (Ehr.) Cleve var. *truncatula* Grun.
18. *Frustulia rhomboides* (Ehr.) de Toni var. *amphipleuroides* Grun.
19. *Frustulia rhomboides* (Ehr.) de Toni.
FIGS. 20 and 21. *Navicula Pusio* Cleve.
FIG. 22. *Neidium oblique-striatum* A. S. var. *nipponica* var. nov.
23. *Navicula confervacea* Kütz. fo. *nipponica* fo. nov.
24. *Neidium oblique-striatum* A. S. var. *apiculata* var. nov.
25. *Navicula Rotæana* (Rabh.) Grun.
26. *Achnanthes pinnata* Hust. var. *japonica* Hust.
27. *Stauroneis Smithii* Grun. var. *incisa* Pant.

PLATE 5

FIG. 1. *Navicula hasta* Pant.
2. *Navicula rhynchocephala* Kütz.
3. *Navicula rostellata* Kütz.
4. *Navicula lanceolata* (Agardh) Kütz.
5. *Navicula placentula* (Ehr.) Grun. fo. *rostrata* Mayer.
6. *Navicula lacustris* Greg.
7. *Navicula globulifera* Hust.
8. *Navicula radiosa* Kütz.
9. *Navicula falaisiensis* Grun. var. *lanceola* Grun.

FIG. 10. *Navicula aqueductæ* Krasske fo. *minores* Krasske.
11. *Navicula crucicula* (W. Smith) Donk. var. *capitata* var. nov.
12. *Navicula lapidosa* Krasske var. *nipponica* var. nov.
13. *Navicula similis* Krasske.
14. *Stauroneis anceps* Ehr. var. *linearis* (Ehr.) Cleve.
15. *Stauroneis anceps* Ehr.
16. *Navicula menisculus* Schumann.
17. *Navicula lanceolata* (Agardh) Kütz. var. *cymbula* (Donk.) Cleve.
18. *Navicula anglica* Ralfs.
19. *Stauroneis phœnicenteron* Ehr.
20. *Stauroneis anceps* Ehr. fo. *gracilis* (Ehr.) Cleve.
21. *Navicula salinatum* Grun. var. *nipponica* var. nov.
22. *Navicula rostellata* Kütz. var. *nipponica* var. nov.
23. *Cymbella hybrida* Grun.
24. *Navicula peregrina* (Ehr.) Kütz. var. *cuneata* var. nov.

PLATE 6

FIG. 1. *Pinnularia platycephala* (Ehr.) Cleve.
2. *Pinnularia platycephala* Cleve var. *Hattoriana* Meister.
3. *Pinnularia karelica* Cleve var. *japonica* Hust. fo. *obtusa* fo. nov.
4. *Pinnularia karelica* Cleve var. *japonica* Hust.
5. *Pinnularia Hartleyana* Greville.
6. *Surirella Pantocsekii* Meister.
7. *Pinnularia microstauron* (Ehr.) Cleve var. *kisakensis* var. nov.
8. *Pinnularia microstauron* (Ehr.) Cleve var. *nipponica* var. nov.
9. *Achnanthes gracillima* Hust. var. *nipponica* var. nov.
10. *Pinnularia major* (Kütz.) Cleve.
11. *Pinnularia viridis* (Nitzsch) Ehr. var. *leptogongyla* (Ehr. Grun.) Cleve.
12. *Pinnularia karelica* Cleve var. *insularis* var. nov.
13. *Pinnularia molaris* Grun.
14. *Pinnularia viridis* (Nitzsch) Ehr. var. *nipponica* var. nov.
15. *Navicula falaisiensis* Grun. var. *nipponica* var. nov.
16. *Navicula cuspidata* Kütz.

PLATE 7

FIG. 1. *Pinnularia Ueno* sp. nov.
FIGS. 2 and 3. *Pinnularia gibba* Ehr.
FIG. 4. *Pinnularia legumen* Ehr. var. *nipponica* var. nov.
5. *Pinnularia dactylus* Ehr. var. *Dariana* A. S. fo. *nipponica* fo. nov.
6. *Pinnularia microstauron* (Ehr.) Cleve.
FIGS. 7 and 8. *Achnanthes exigua* Grun. var. *nipponica* var. nov.
FIG. 9. *Pinnularia viridis* (Nitzsch) Ehr. var. *intermedia* Cleve.
10. *Pinnularia gibba* Ehr. var. *nipponica* var. nov.
11. *Pinnularia major* (Kütz.) Cleve var. *linearis* Cleve.
12. *Pinnularia nipponica* sp. nov.
13. *Pinnularia Okamuræ* sp. nov.
14. *Navicula cryptocephala* Kütz. var. *veneta* (Kütz.) Grun.

FIG. 15. *Pinnularia gibba* Ehr. fo. *subundulata* Mayer.
16. *Achnanthes exigua* Grun.
17. *Pinnularia borealis* Ehr.
18. *Pinnularia microstauron* (Ehr.) Grun. var. *ambigua* Meister fo. *diminuta* Grun.

PLATE 8

FIG. 1. *Neidium nipponica* sp. nov.
2. *Pinnularia viridis* (Nitzsch) Ehr. var. *nipponica* var. nov.
3. *Hantzschia elongata* (Hantz.) Grun.
4. *Navicula palea* sp. nov.
5. *Pinnularia Hustedtii* Meister.
6. *Pinnularia legumen* Ehr.
7. *Rhopalodia parallela* (Grun.) O. Mull.
8. *Achnanthes lanceolata* Breb. var. *rostrata* Hust.
9. *Navicula lacustris* Greg.
10. *Eunotia tropica* Hust.
11. *Actinella brasiliensis* Grun.
12. *Rhopalodia gibberula* (Ehr.) O. Mull.
13. *Cyclotella comta* (Ehr.) Kütz. fo. *parva* fo. nov.
14. *Cyclotella Meneghiniana* Kütz. var. *nipponica* var. nov.
15. *Pinnularia leptosoma* Grun. var. *nipponica* var. nov.
16. *Eunotia tropica* Hust.
17. *Surirella nipponica* sp. nov.

PLATE 9

FIG. 1. *Diploneis Smithii* (Breb.) Cleve var. *oblongella* var. nov.
2. *Rhopalodia gibba* (Ehr.) O. Mull.
3. *Caloneis silicula* (Ehr.) Cleve var. *tumida* Hust. fo. *nipponica* fo. nov.
4. *Stauroneis phœnicenteron* Ehr. fo. *nipponica* fo. nov.
5. *Pinnularia tabellaria* Ehr.
6. *Navicula perpusilla* Grun.
7. *Pinnularia viridis* (Nitzsch) Ehr. var. *fallax* Cleve.
8. *Navicula leptosoma* Grun.
9. *Pinnularia montana* Hust. fo. *minor* fo. nov.
10. *Pinnularia microstauron* (Ehr.) Cleve var. *nipponica* var. nov.
11. *Rhopalodia parallela* (Grun.) O. Mull.
12. *Epithemia cistula* (Ehr.) var. *lunaris* Grun.
13. *Ceratoneis arcus* Kütz. var. *amphioxys* (Rabh.).
14. *Gyrosigma acuminatum* (Kütz.) Rabh.
15. *Fragilaria virescens* Ralfs.
16. *Ceratoneis arcus* Kütz. var. *amphioxys* (Rabh.).
17. *Cymbella sinuata* Greg. var. *antiqua* Grun.
18. *Diatoma hiemale* (Lyngb.) Heiberg var. *mesodon* (Ehr.) Grun.
19. *Cymbella aspera* (Ehr.) Cleve var. *truncata* (Rabh.) Dipp.
20. *Navicula amphibola* Cleve.
21. *Pinnularia viridis* (Nitzsch) Ehr. var. *sudetica* (Hilse) Hust.

PLATE 10

FIG. 1. *Pinnularia nobilis* Ehr.
2. *Nitzschia sigmoides* (Ehr.) W. Smith.
3. *Navicula cryptocephala* Kütz.
4. *Cymbella japonica* Reichelt.
5. *Navicula lanceolata* (Agardh) Kütz.
6. *Melosira Binderana* Kütz.
7. *Diatoma vulgare* Bory var. *linearis* Grun.
8. *Gomphonema gracile* Ehr. var. *lanceolata* (Kütz.) Cleve.
9. *Synedra japonica* Meister.
10. *Synedra Ulna* (Nitzsch) Ehr. var. *danica* (Kütz.) Grun.
11. *Gomphonema vastum* Hust. var. *cuneata* var. nov.
12. *Melosira distans* (Ehr.) Kütz. var. *lirata* (Ehr.) Bethge.
13. *Diatoma hiemale* (Lyngb.) Heiberg.
14. *Cymbella Reinhardtii* Grun.
15. *Fragilaria construens* (Ehr.) Grun. var. *nipponica* var. nov.
16. *Navicula atomus* (Naeg.) Grun. var. *nipponica* var. nov.
17. *Achnanthes linearis* W. Smith var. *pusilla* Grun.
18. *Achnanthes lanceolata* Breb. var. *rostrata* Hust.
19. *Gomphonema subtile* Ehr. var. *sagitta* Schum.
20. *Navicula placenta* (Ehr.) Grun. fo. *nipponica* fo. nov.
21. *Epithemia zebra* (Ehr.) Kütz. var. *saxonica* (Kütz.) Grun.
22. *Synedra Goulardii* (Breb.) Grun.
23. *Stauroneis Smithii* Grun. var. *nipponica* var. nov.
24. *Surirella Terryana* Ward fo. *minuta* fo. nov.
25. *Diatoma hiemale* (Lyngb.) Heiberg var. *mesodon* (Ehr.) Grun.
26. *Pinnularia lignitica* Cleve.
27. *Achnanthes affinis* Grun. var. *minuta* var. nov.
28. *Meridion circulare* Agardh var. *constricta* (Ralfs) Van Heurck.
29. *Synedra nana* Meister var. *nipponica* var. nov.
30. *Stenopterobia intermedia* (Lewis) fo. *subacuta* Fricke.
31. *Gomphonema quadripunctatum* (Oestr.) Wislouch var. *hastata* Wislouch.
32. *Fragilaria construens* (Ehr.) Grun. var. *triundulata* Reichelt.
33. *Cymbella prostrata* (Berkeley) Cleve.

PLATE 11

FIG. 1. *Cymbella japonica* Reichelt.
2. *Cymbella æqualis* W. Smith.
3. *Cymbella Ehrenbergii* Kütz.
4. *Cymbella heteropleura* Ehr. var. *minor* Cleve.
5. *Cymbella gracilis* Rabh.
6. *Cymbella naviculiformis* Auerswald.
7. *Cymbella japonica* Reichelt.
8. *Cymbella ventricosa* Kütz.

FIGS. 9 and 10. *Cymbella affinis* Kütz.

FIG. 11. *Navicula minuscula* Grun.
12. *Anomœoneis exilis* (Kütz.) Cleve var. *nipponica* var. nov.
13. *Cymbella heteropleura* Ehr. fo. *nipponica* fo. nov.
14. *Cymbella ventricosa* Kütz.
15. *Cymbella sinuata* Greg.

FIG. 16. *Cymbella tumida* (Breb.) Van Heurck var. *borealis* Grun.
17. *Cymbella tumida* (Breb.) Van Heurck.
18. *Cymbella ventricosa* Kütz.
19. *Fragilaria construens* (Ehr.) Grun. var. *subsalina* Hustedt.
20. *Cymbella turgida* (Greg.) Cleve.
21. *Cymbella cymbiformis* (Agardh, Kütz.) Van Heurck.
22. *Navicula Pusio* Cleve.
23. *Cymbella cuspidata* Kütz.
24. *Cymbella turgidula* Grun.
25. *Cymbella microcephala* Grun.

PLATE 12

FIG. 1. *Pinnularia brevicostata* Cleve.
2. *Cyclotella comta* (Ehr.) Kütz. var. *paucipunctata* Grun.
3. *Gomphonema nipponica* sp. nov.
4. *Gomphonema acuminatum* Ehr. var. *turris* (Ehr.) Cleve.
5. *Gyrosigma scalproides* (Rabh.) Cleve.
6. *Opephora Okadæ* sp. nov.
7. *Gomphonema lanceolatum* Ehr. var. *insignis* (Greg.) Cleve.
8. *Opephora Martyi* Herib. var. *robusta* var. nov.
9. *Diploneis marginestriata* Hust.
10. *Neidium dubium* (Ehr.) Cleve.
11. *Pinnularia mesolepta* (Ehr.) W. Smith.
12. *Cymbella alpina* Grun.
13. *Achnanthes lanceolata* Breb. var. *nipponica* var. nov.
14. *Surirella tenera* Greg. var. *punctata* var. nov.
15. *Navicula pupula* Kütz.
16. *Gomphonema Berggrenii* Cleve.
17. *Achnanthes Oestrupii* (A. Cleve) Hust.
18. *Pinnularia viridis* (Nitzsch) Ehr. var. *fallax* Cleve.
19. *Neidium Kozlowi* Meresch. var. *nipponica* var. nov.
20. *Fragilaria virescens* Ralfs var. *elliptica* Hust. fo. *nipponica* fo. nov.
21. *Fragilaria pinnata* Ehr.
22. *Cymbella gracilis* (Rabh.) Cleve fo. *minor* fo. nov.
23. *Eunotia septentrionalis* Oestr.
24. *Pinnularia divergentissima* Grun.
25. *Eunotia prærupta* Ehr.
26. *Achnanthes Hauckiana* Grun.

PLATE 13

FIG. 1. *Nitzschia interrupta* (Reich.) Hust.
2. *Nitzschia palea* (Kütz.) W. Smith var. *tenuirostris* Grun.
3. *Opephora Martyi* Herib.
4. *Surirella ovalis* Breb. var. *nipponica* var. nov.
5. *Gomphonema vastum* Hust.
FIGS. 6 and 7. *Gomphonema lingulatum* Hust.
FIG. 8. *Gomphonema acuminatum* Ehr. var. *coronata* (Ehr.) W. Smith.
9. *Gomphonema parvulum* (Kütz.) Grun. var. *micropus* (Kütz.) Cleve.
10. *Opephora Martyi* Herib. var. *robusta* var. nov.

FIG. 11. *Hantzschia amphioxys* (Ehr.) Grun.
12. *Opephora Martyi* Herib. var. *elongata* var. nov.
13. *Gomphonema constrictum* Ehr.
14. *Gomphonema intricatum* Kütz.
15. *Nitzschia communis* Rabh.
16. *Gomphonema parvulum* (Kütz.) Grun.
FIGS. 17 and 18. *Nitzschia dissipata* (Kütz.) Grun.
FIG. 19. *Nitzschia palea* (Kütz.) W. Smith.
20. *Gomphonema constrictum* Ehr.
21. *Gomphonema parvulum* (Kütz.) Grun. var. *exilissima* Grun.
22. *Gomphonema olivaceum* (Lyngb.) Kütz.
23. *Gomphonema constrictum* Ehr. var. *capitata* (Ehr.) Cleve.
24. *Gomphonema nipponica* sp. nov.
25. *Nitzschia recta* Hantzsch.
26. *Nitzschia dissipata* (Kütz.) Grun.
27. *Nitzschia acicularis* W. Smith var. *nipponica* var. nov.
28. *Nitzschia palea* (Kütz.) W. Smith.
29. *Nitzschia vitrea* Norman?
30. *Nitzschia capitellata* Hust. var. *nipponica* var. nov.
31. *Gomphonema augur* Ehr.
32. *Gomphonema lanceolatum* Ehr. var. *insignis* (Greg.) Cleve.
33. *Gomphonema vastum* Hust. var. *elongata* var. nov.
34. *Gomphonema parvulum* (Kütz.) Grun.
35. *Nitzschia fonticola* Grun.
36. *Gomphonema parvulum* (Kütz.) Grun. var. *micropus* (Kütz.) Cleve fo. *nipponica* fo. nov.
37. *Synedra cyclopum* Brutschi var. *nipponica* var. nov.
38. *Gomphonema acuminatum* Ehr.
39. *Gomphonema olivaceum* (Lyngb.) Kütz. var. *minutissima* Hust.
40. *Gomphonema vastum* Hust. var. *elongata* var. nov.
41. *Gomphonema intricatum* Kütz.
42. *Gomphonema abbreviatum* Agardh? Kütz.

PLATE 14

FIG. 1. *Cymatopleura elliptica* (Breb.) W. Smith.
2. *Diploneis oculata* (Breb.) Cleve var. *nipponica* var. nov.
3. *Surirella robusta* Ehr. var. *splendida* (Ehr.) Van Heurck.
4. *Eunotia faba* (Ehr.) Grun. var. *nipponica* var. nov.
5. *Surirella Capronii* Breb. var. *obtusa* Hust.
6. *Achnanthes Hauckiana* Grun. var. *elliptica* Schulz. fo. *nipponica* fo. nov.
7. *Surirella linearis* W. Smith var. *constricta* (Ehr.) Grun.
8. *Fragilaria Harrissonii* W. Smith var. *rhomboides* Grun.
9. *Fragilaria brevistriata* Grun.
10. *Eunotia pectinalis* (Kütz.) Rabh. var. *minor* (Kütz.) Rabh. fo. *impressa* (Ehr.).
11. *Surirella biseriata* Breb. var. *nipponica* var. nov.
12. *Surirella biseriata* Breb.
13. *Surirella tenera* Greg.
14. *Surirella biseriata* Breb. var. *constricta* Grun. fo. *punctata* fo. nov.
15. *Surirella tenera* Greg. var. *nervosa* A. Schmidt.

PLATE 15

FIG. 1. *Surirella biseriata* Breb. var. *bifrons* (Ehr.) Hust. fo. *hispida* fo. nov.
2. *Surirella Terryana* Ward var. *nipponica* var. nov.
3. *Surirella biseriata* Breb. var. *nipponica* fo. *punctata* fo. nov.
4. *Surirella elegans* Ehr. fo. *elongata* fo. nov.
5. *Navicula mutica* Kütz.
6. *Cymatopleura solea* (Breb.) W. Smith var. *gracilis* Grun.
7. *Cymatopleura solea* (Breb.) W. Smith var. *regula* (Ehr.) Grun.
8. *Surirella linearis* W. Smith var. *nipponica* var. nov. fo. *constricta* fo. nov.
9. *Surirella linearis* W. Smith var. *nipponica* var. nov.
10. *Cymbella Kawamuræ* sp. nov.
11. *Surirella linearis* W. Smith.
12. *Epithemia sorex* Kütz.
13. *Surirella Terryana* Ward fo. *minuta* fo. nov.

PLATE 16

FIG. 1. *Surirella robusta* Ehr. var. *splendida* (Ehr.) Van Heurck fo. *constricta* Hust.
2. *Surirella robusta* Ehr. var. *splendida* (Ehr.) Van Heurck fo. *punctata* Hust.
3. *Surirella linearis* W. Smith var. *apiculata* var. nov.
4. *Surirella Capronii* Breb. var. *obtusa* Hust. fo. *capitata* fo. nov.
5. *Fragilaria Harrissonii* W. Smith.
6. *Fragilaria Harrissonii* W. Smith var. *dubia* Grun.
7. *Fragilaria brevistriata* Grun. var. *nipponica* var. nov.
8. *Surirella linearis* W. Smith var. *helvetica* (Brun) Meister.
9. *Fragilaria construens* (Ehr.) Grun. var. *binodis* (Ehr.) Grun.
10. *Surirella robusta* Ehr. fo. *lata* Hust.
11. *Surirella Terryana* Ward.
12. *Navicula kizakiensis* sp. nov.
13. *Fragilaria construens* (Ehr.) Grun. var. *nipponica* var. nov.
14. *Pinnularia Balfouriana* Grun. var. *stauroptera* var. nov.
15. *Pinnularia borealis* Ehr.

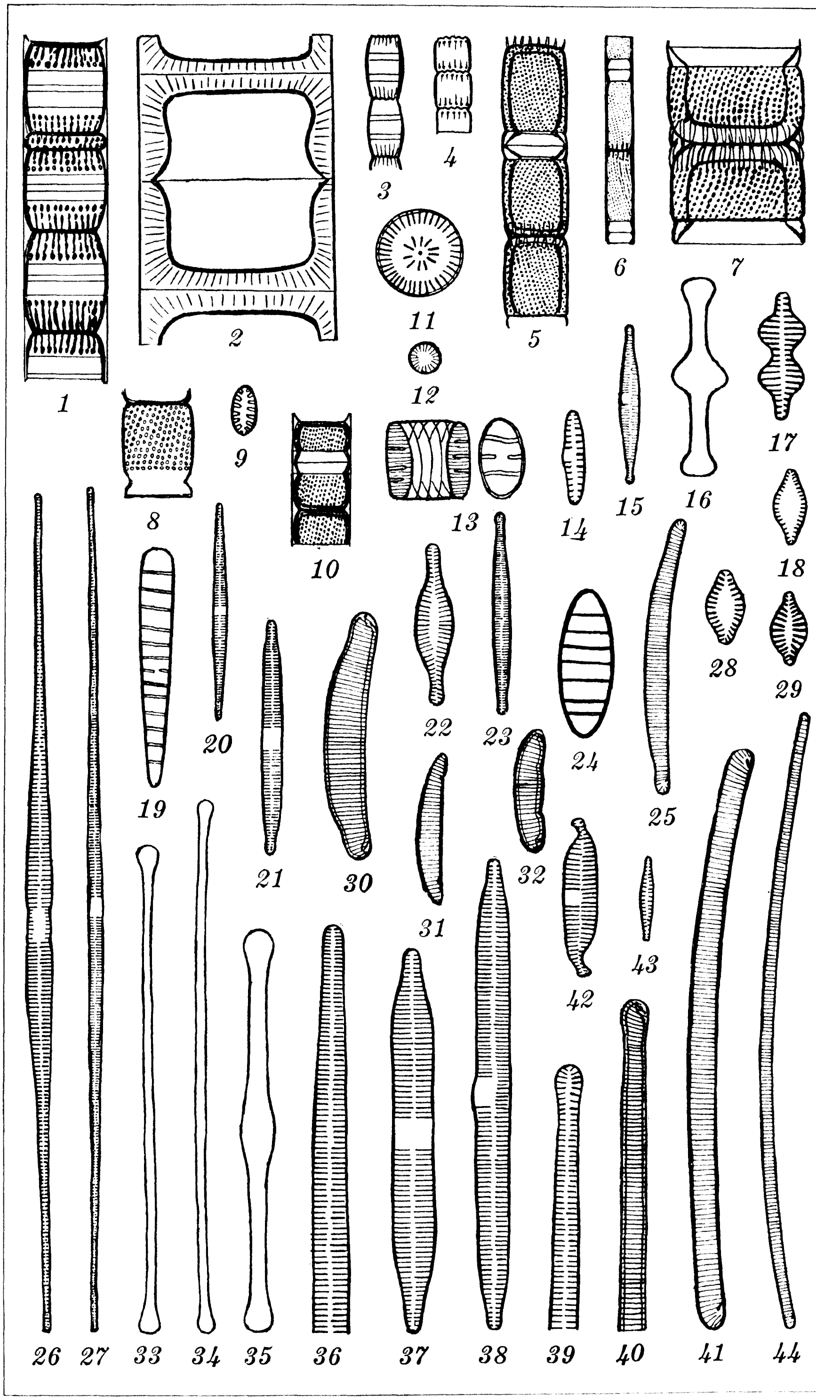

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44

PLATE 1.

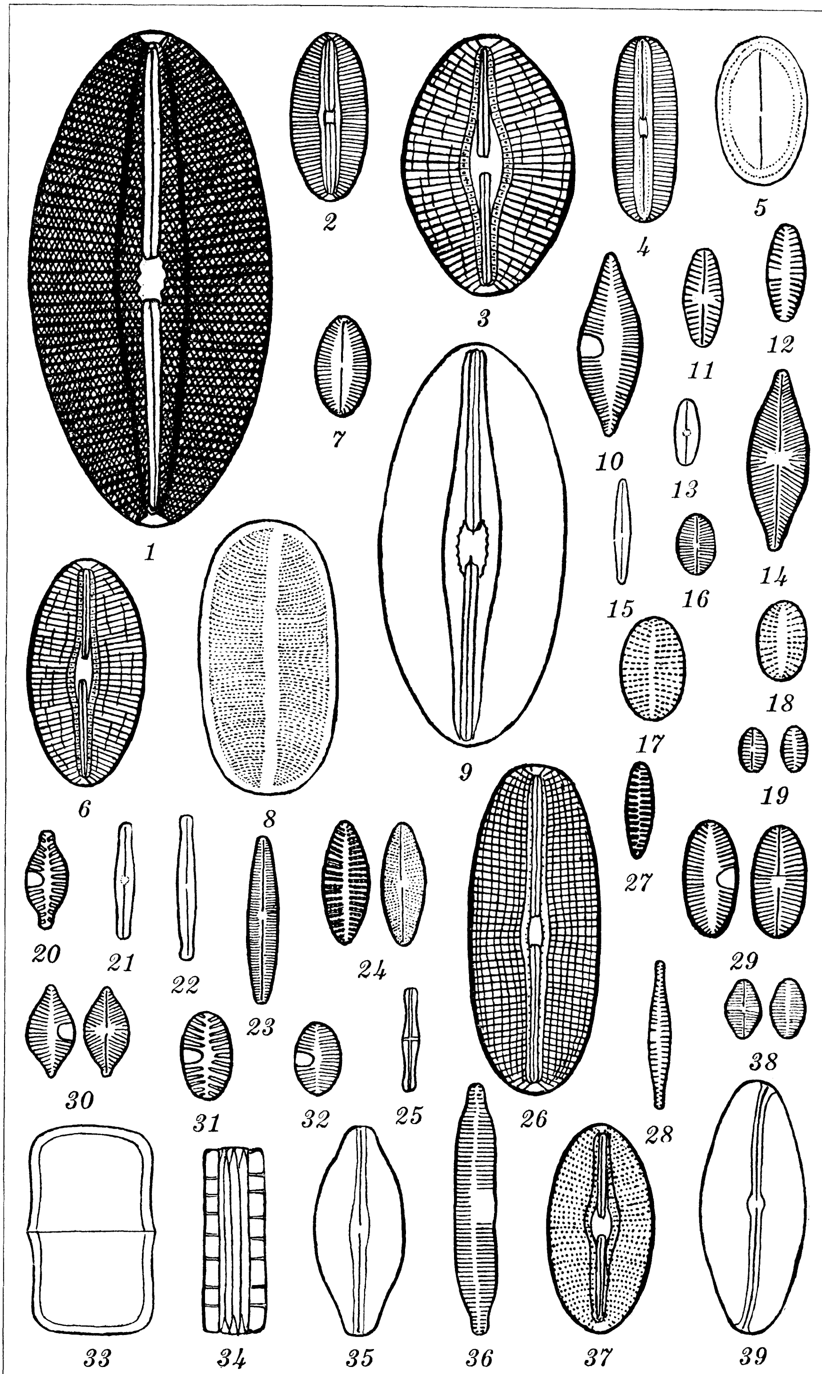

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39

PLATE 2.

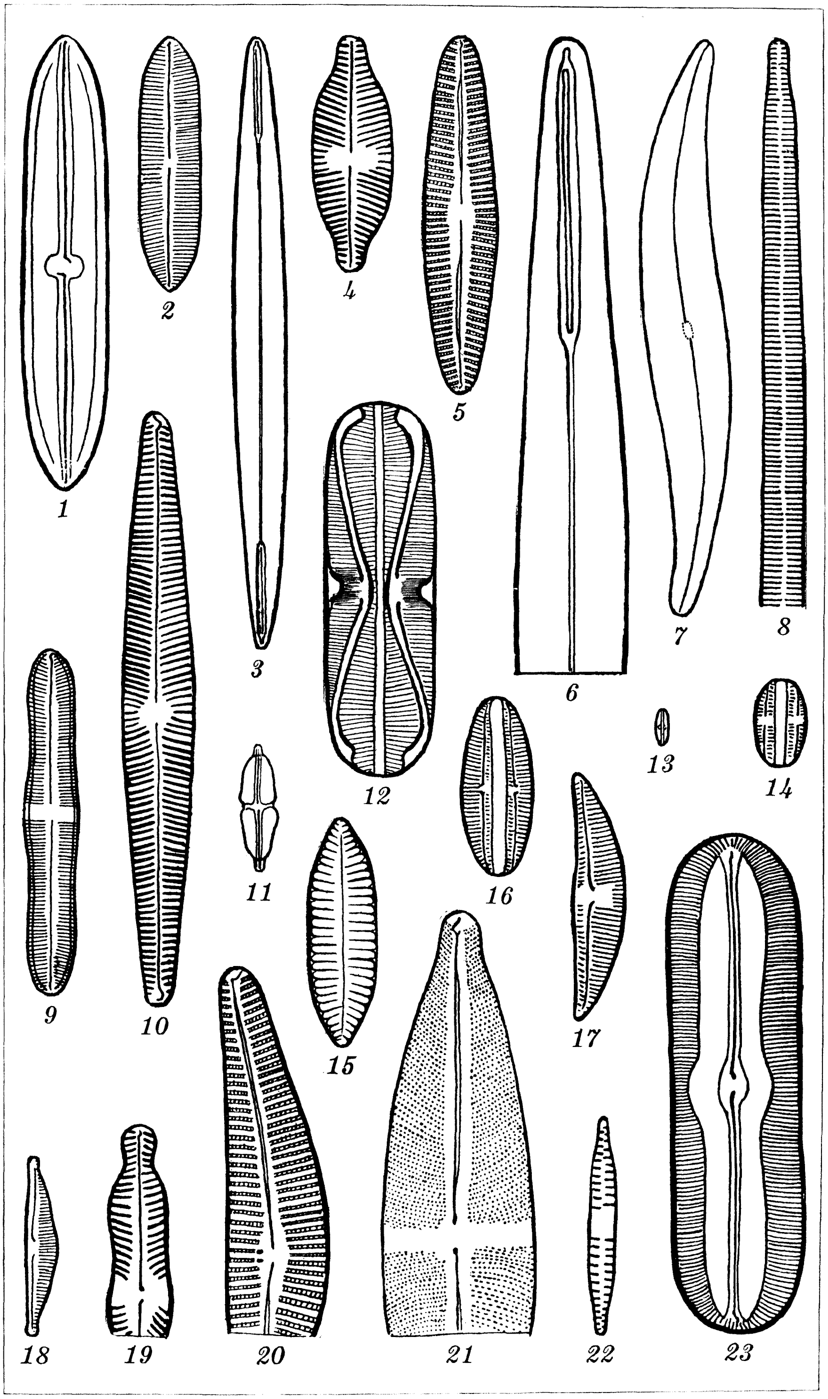


PLATE 3.

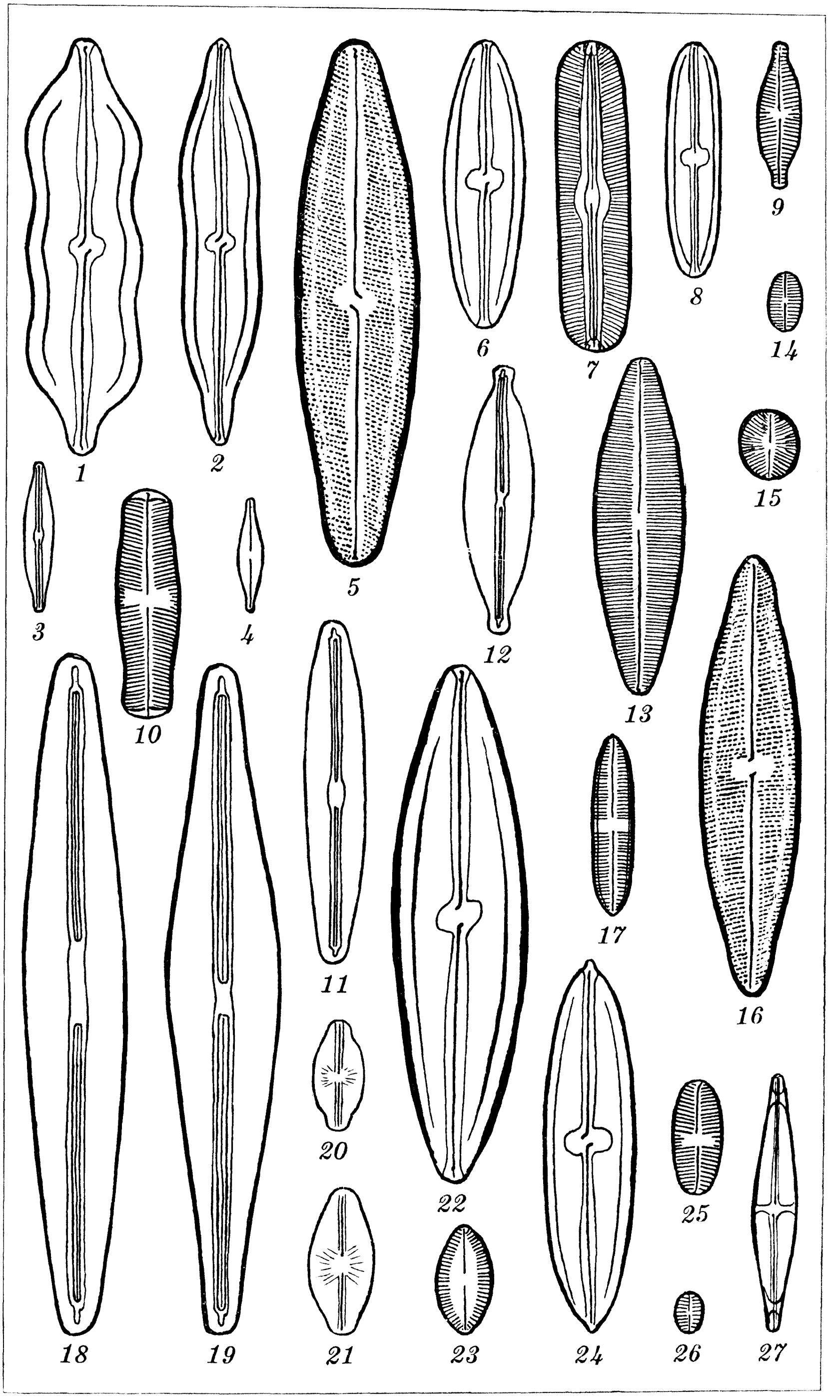


PLATE 4.

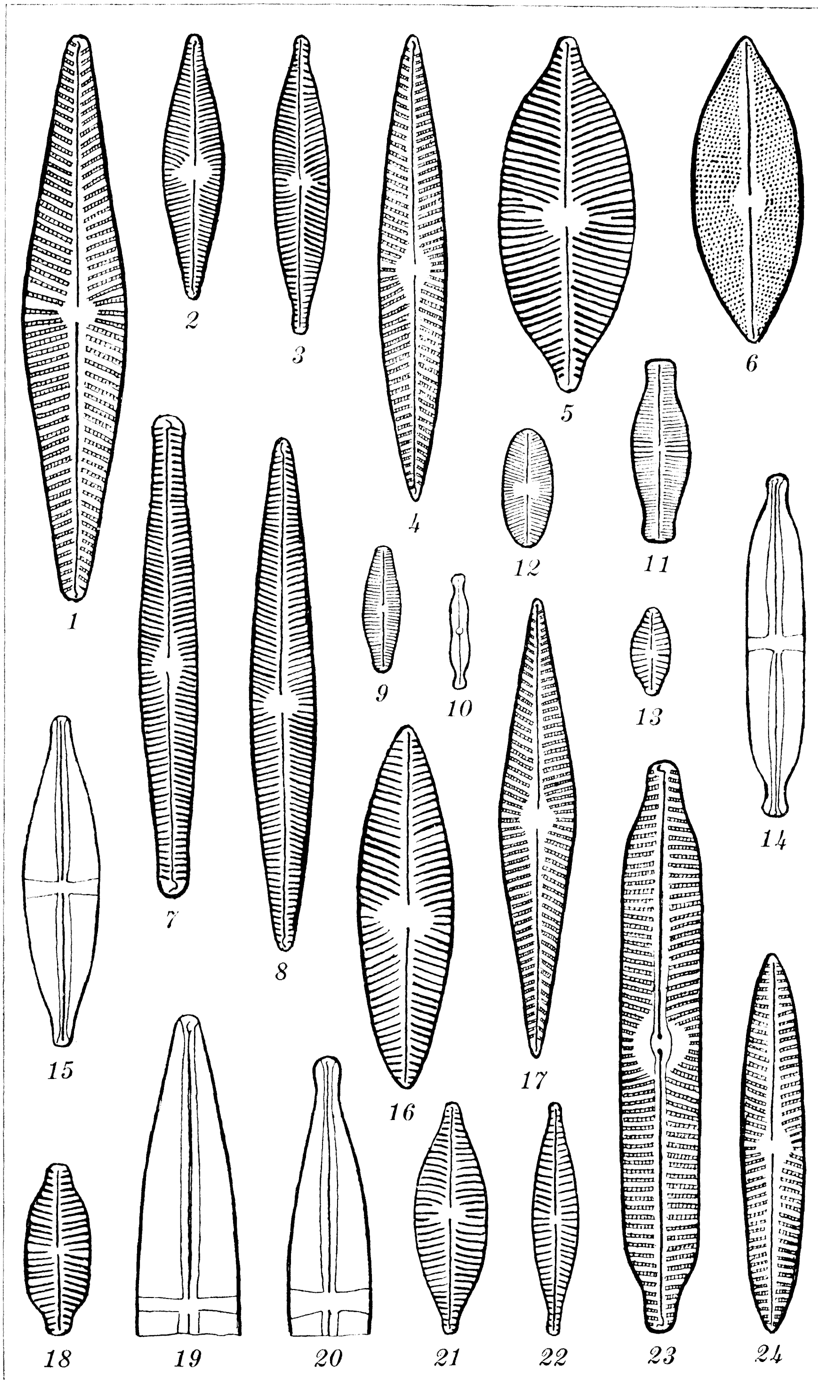


PLATE 5.

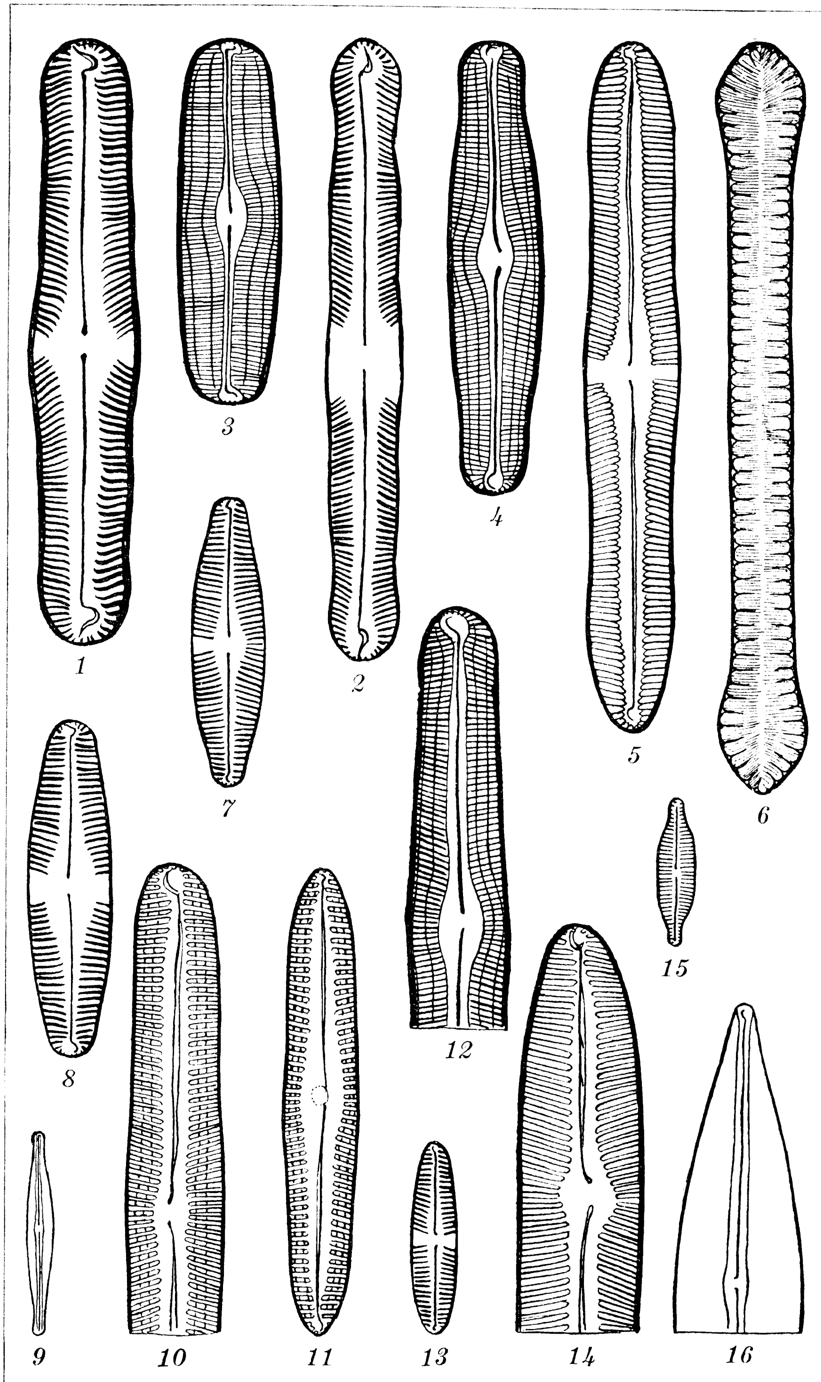


PLATE 6.

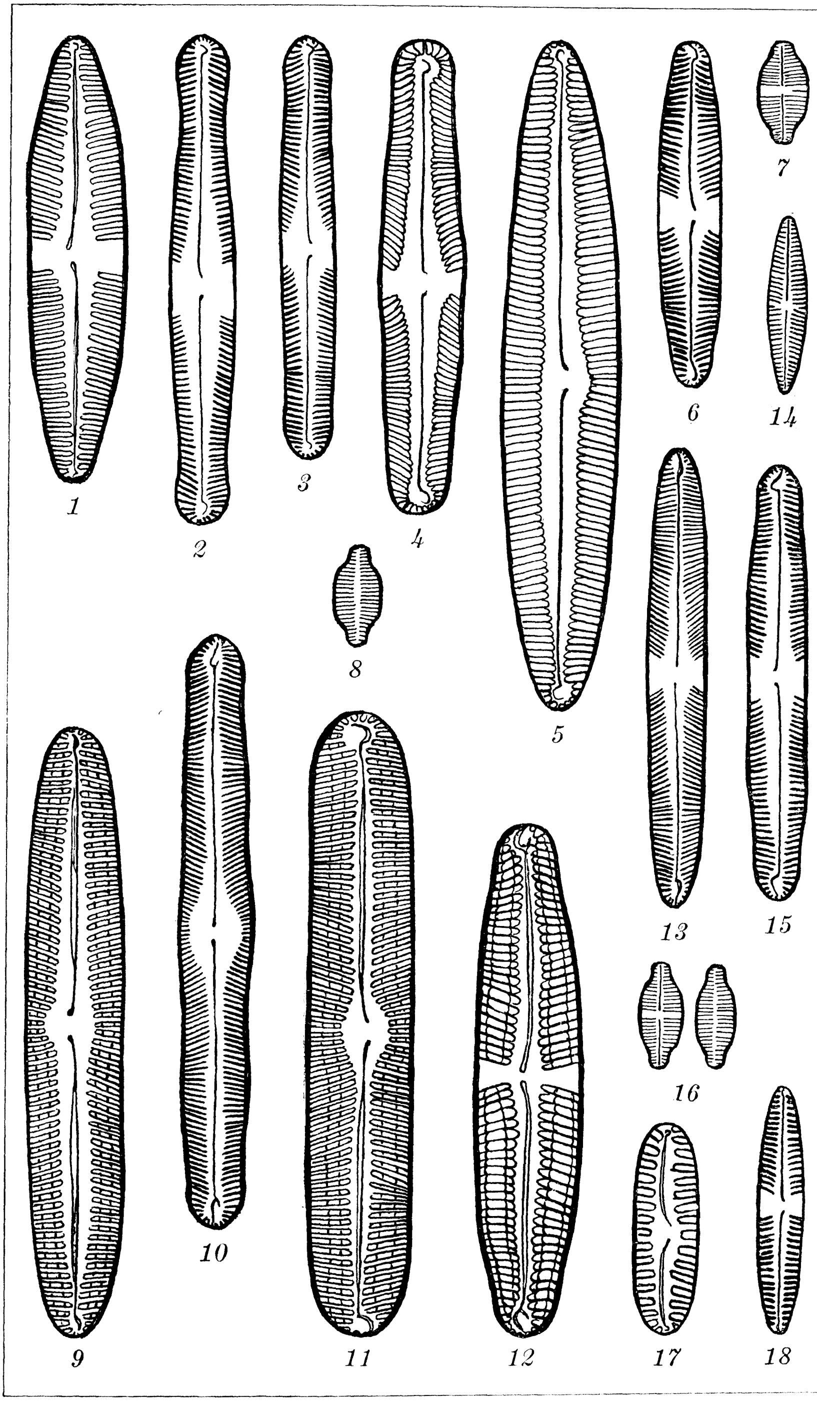


PLATE 7.

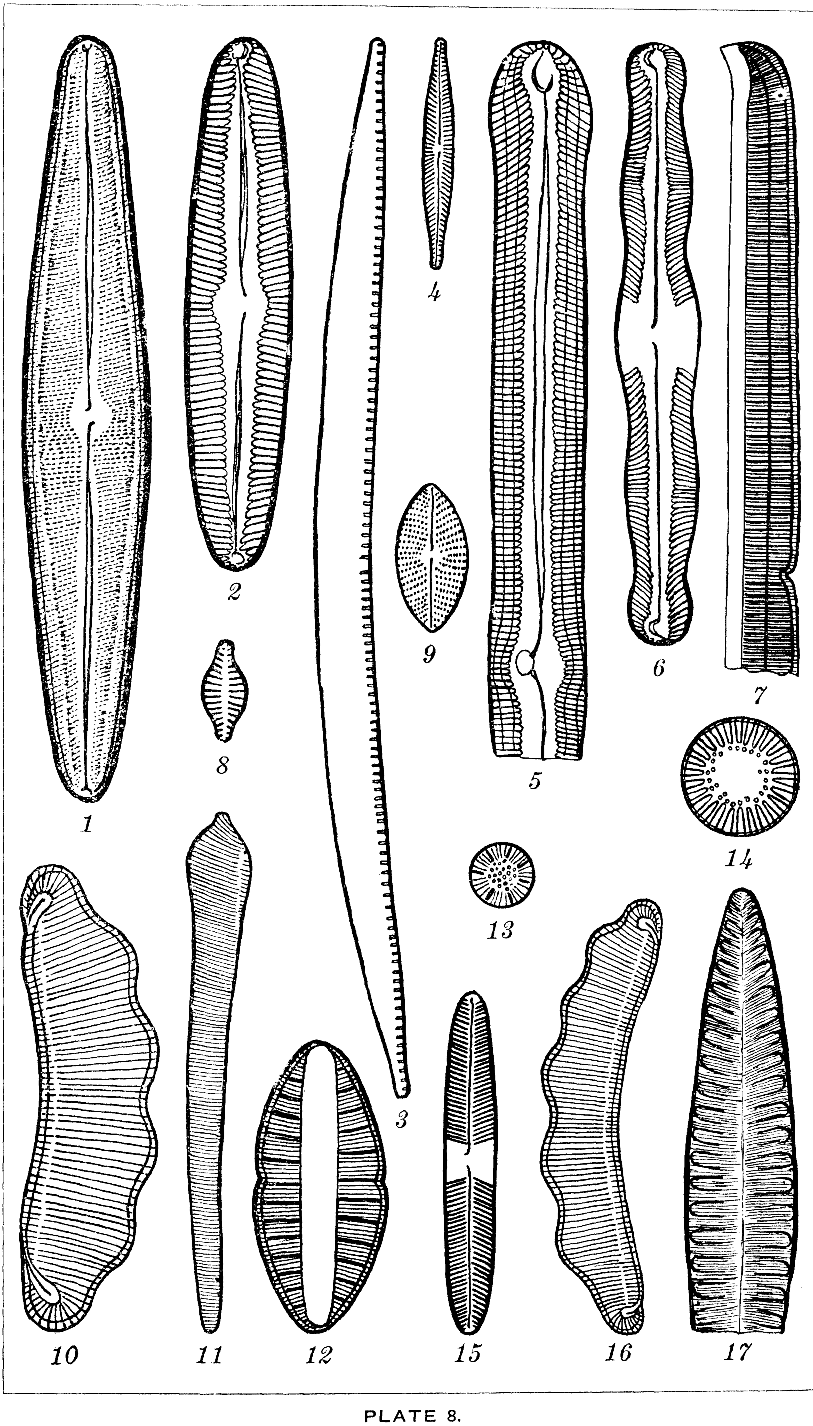


PLATE 8.

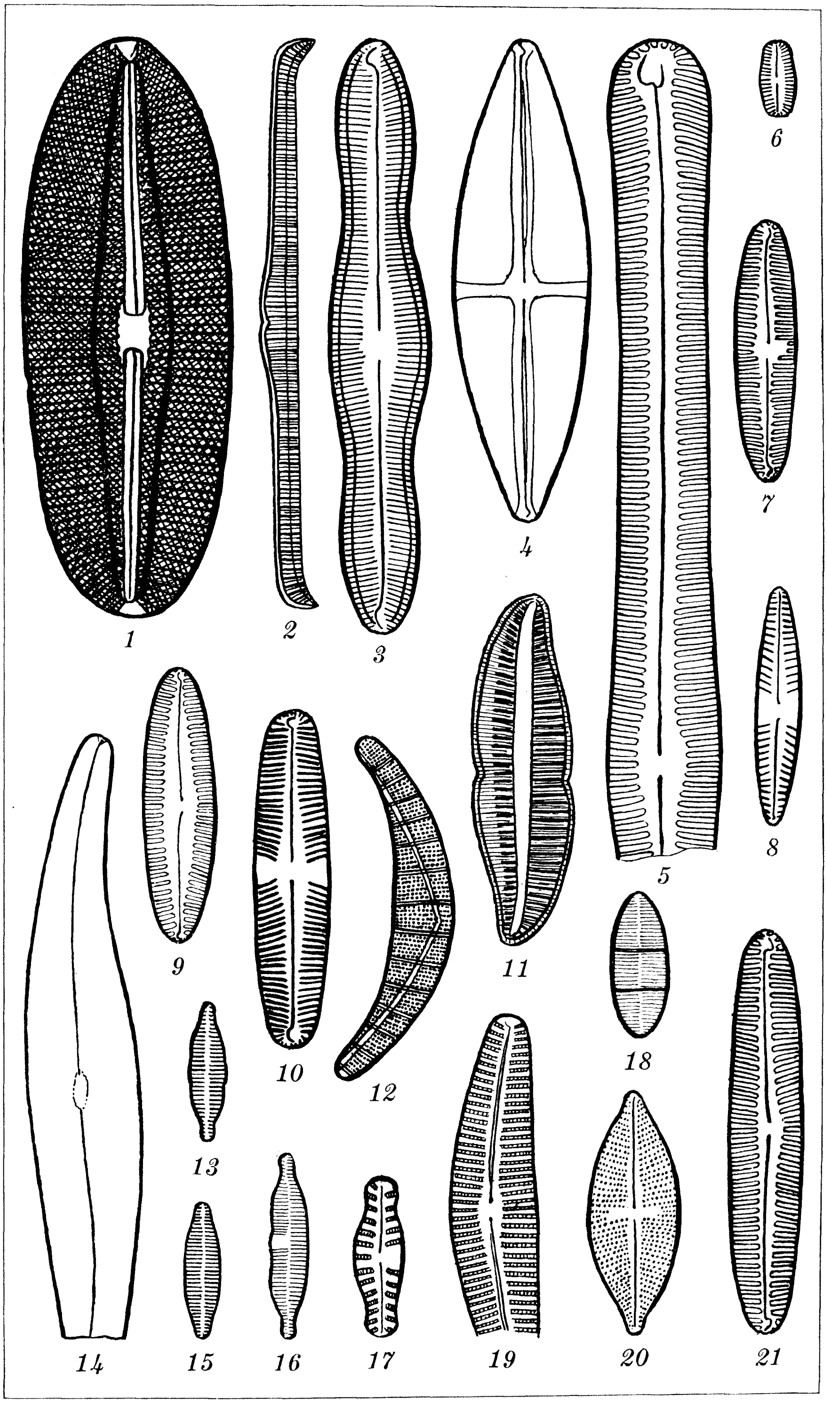


PLATE 9.

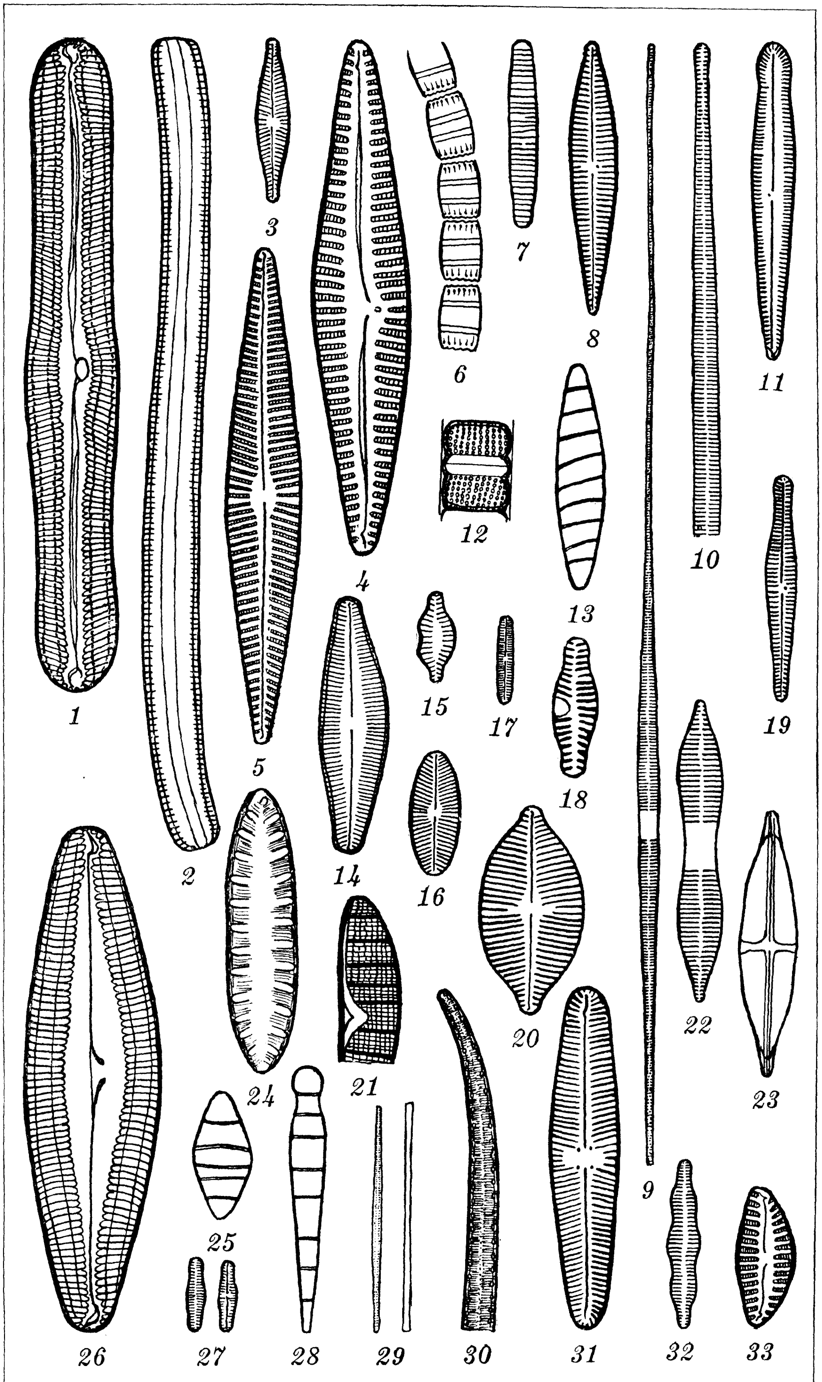

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33

PLATE 10.

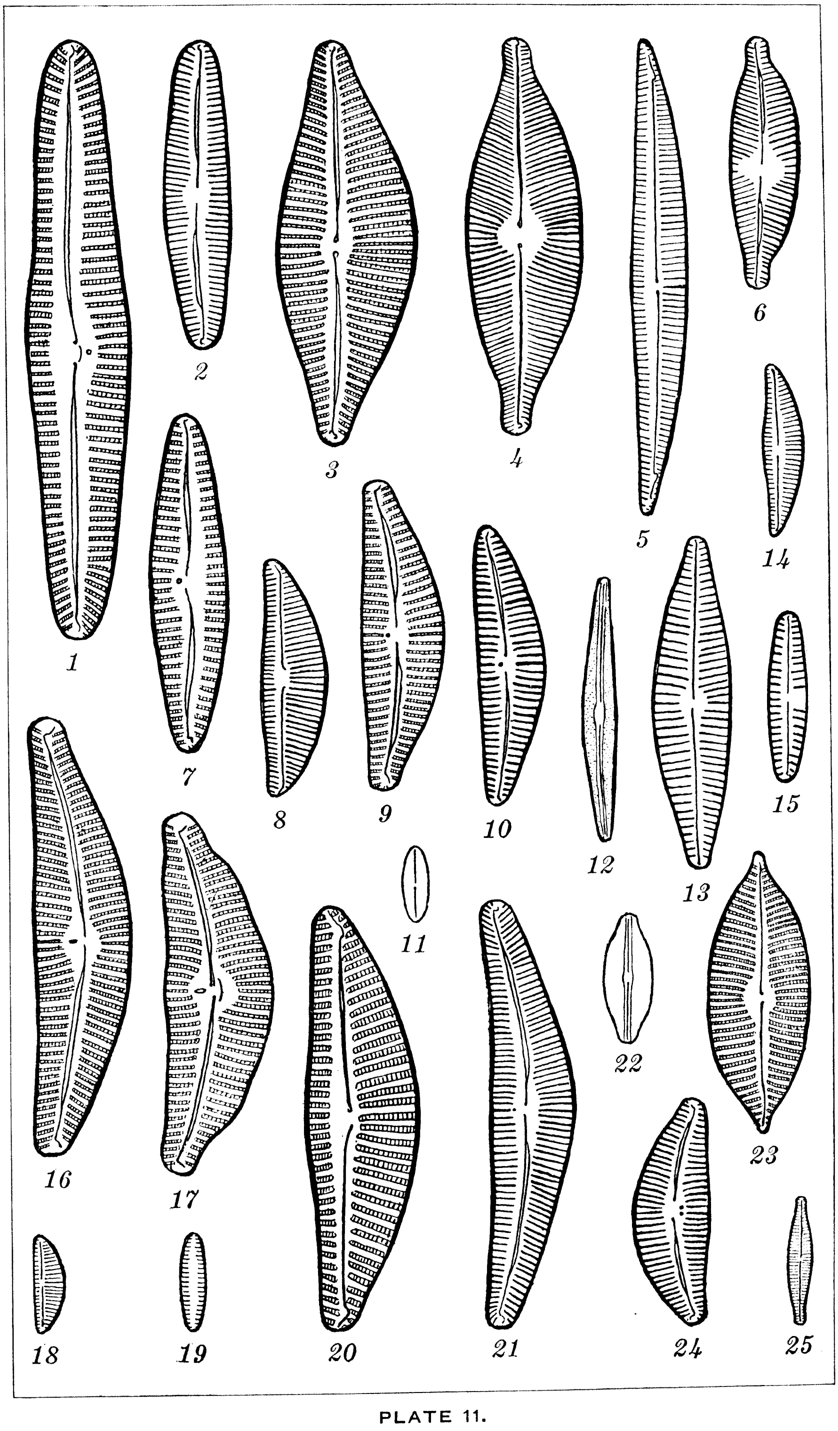


PLATE 11.

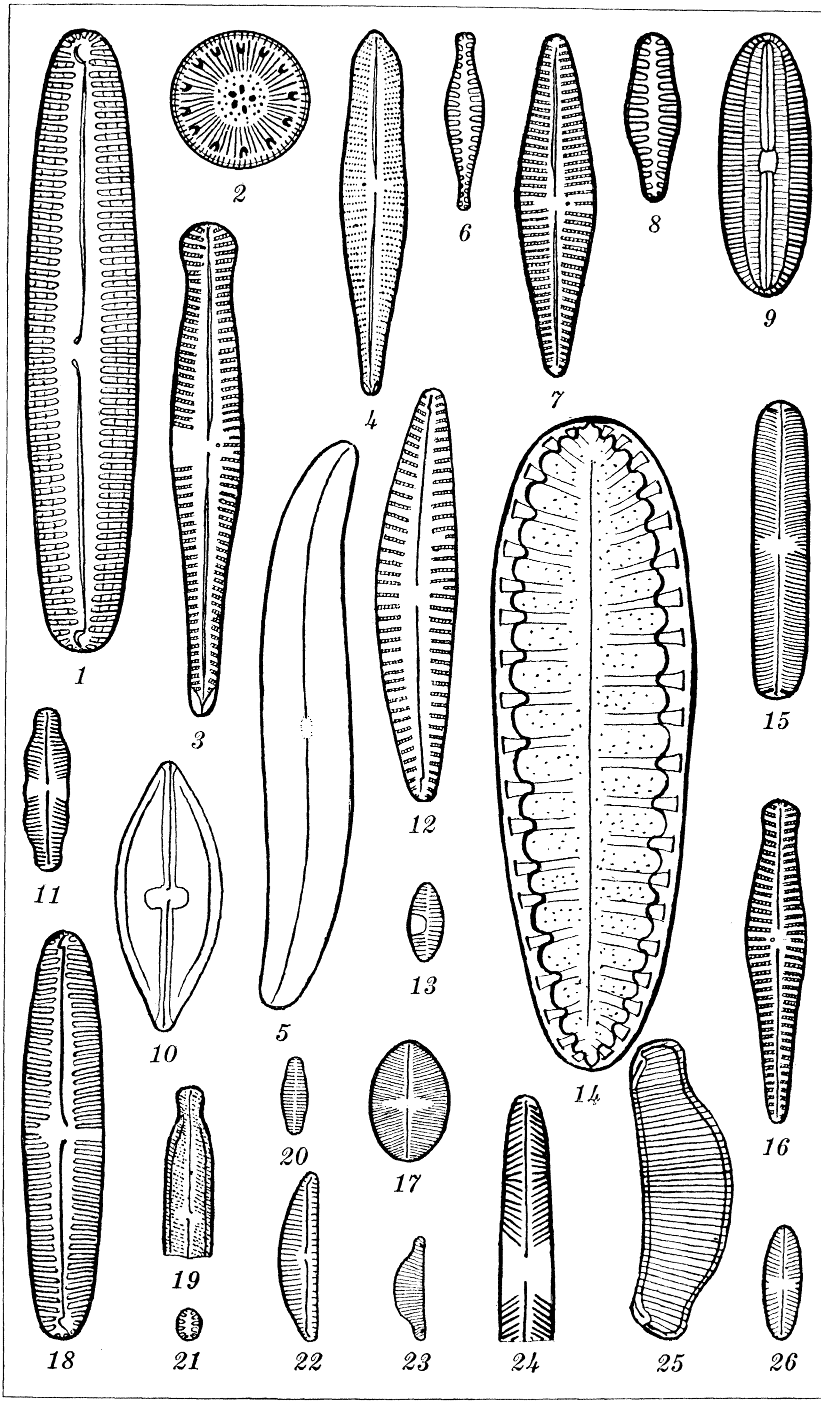


PLATE 12.

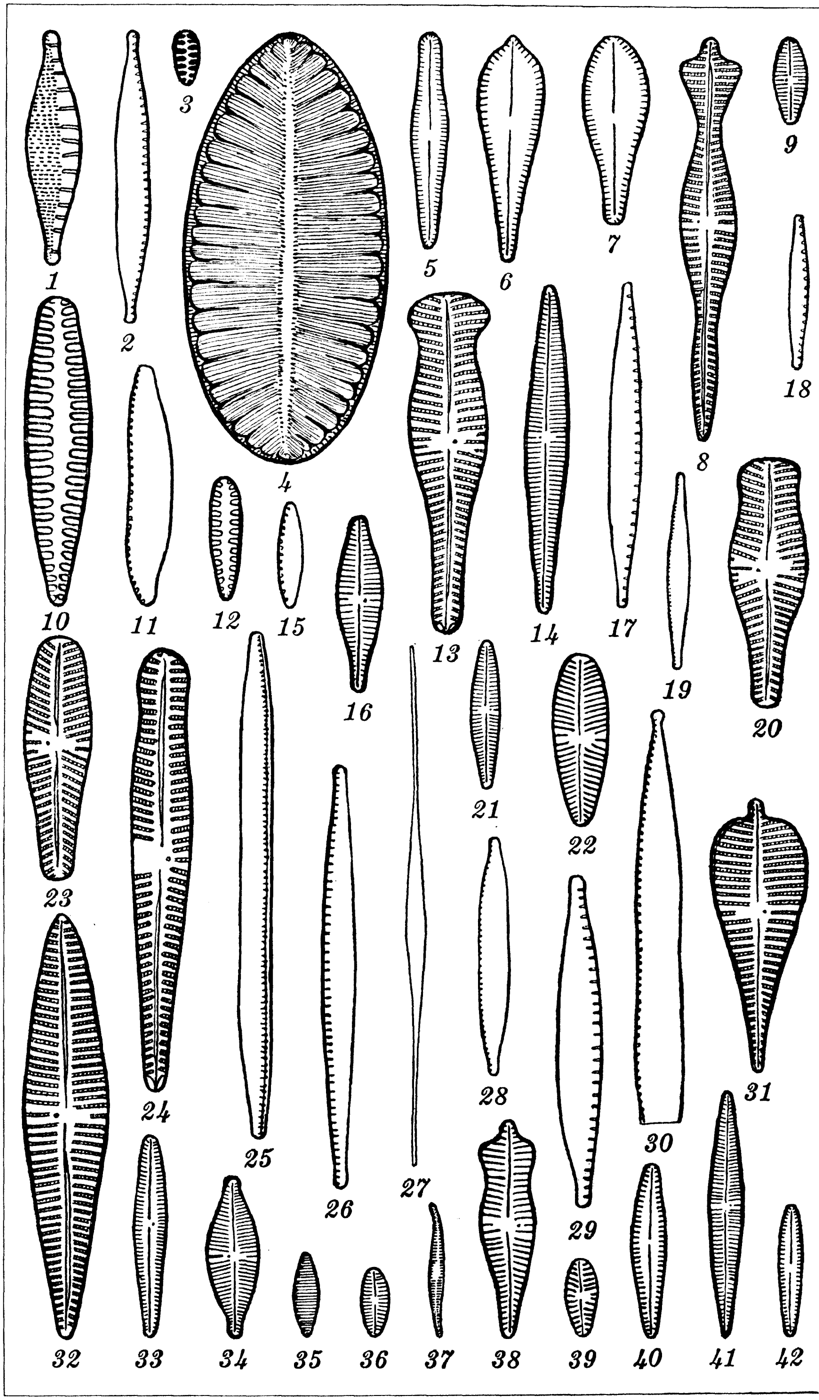

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42

PLATE 13.

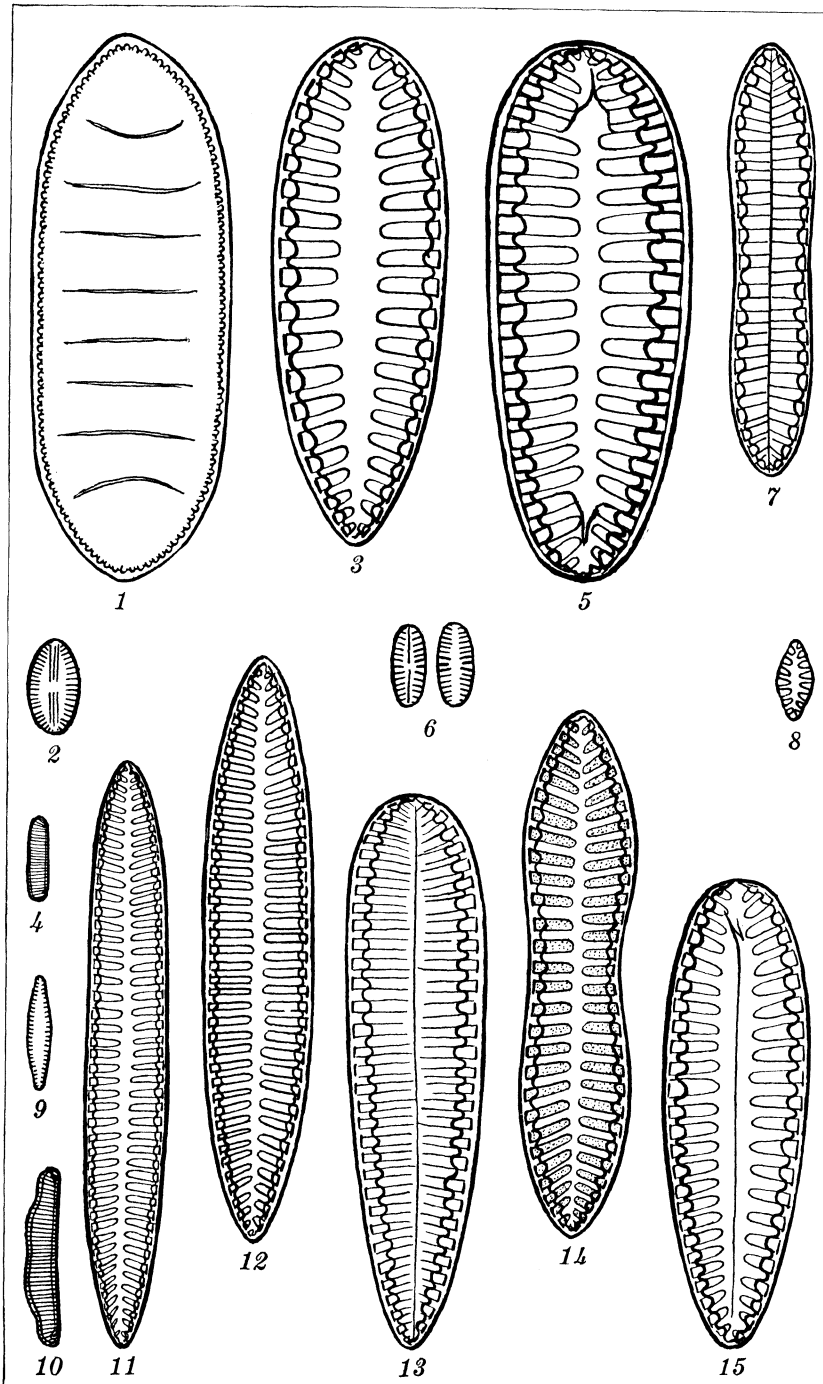


PLATE 14.

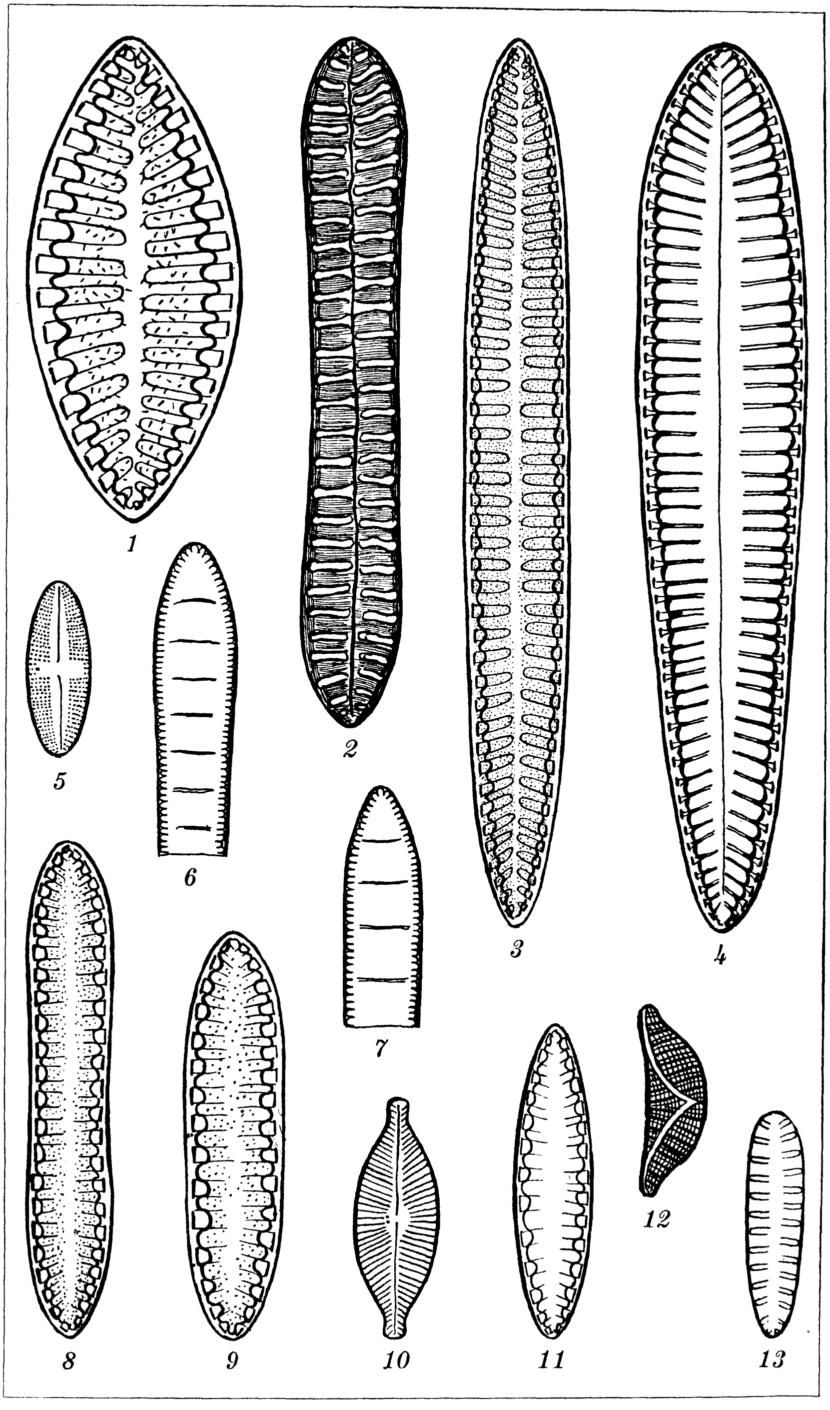


PLATE 15.

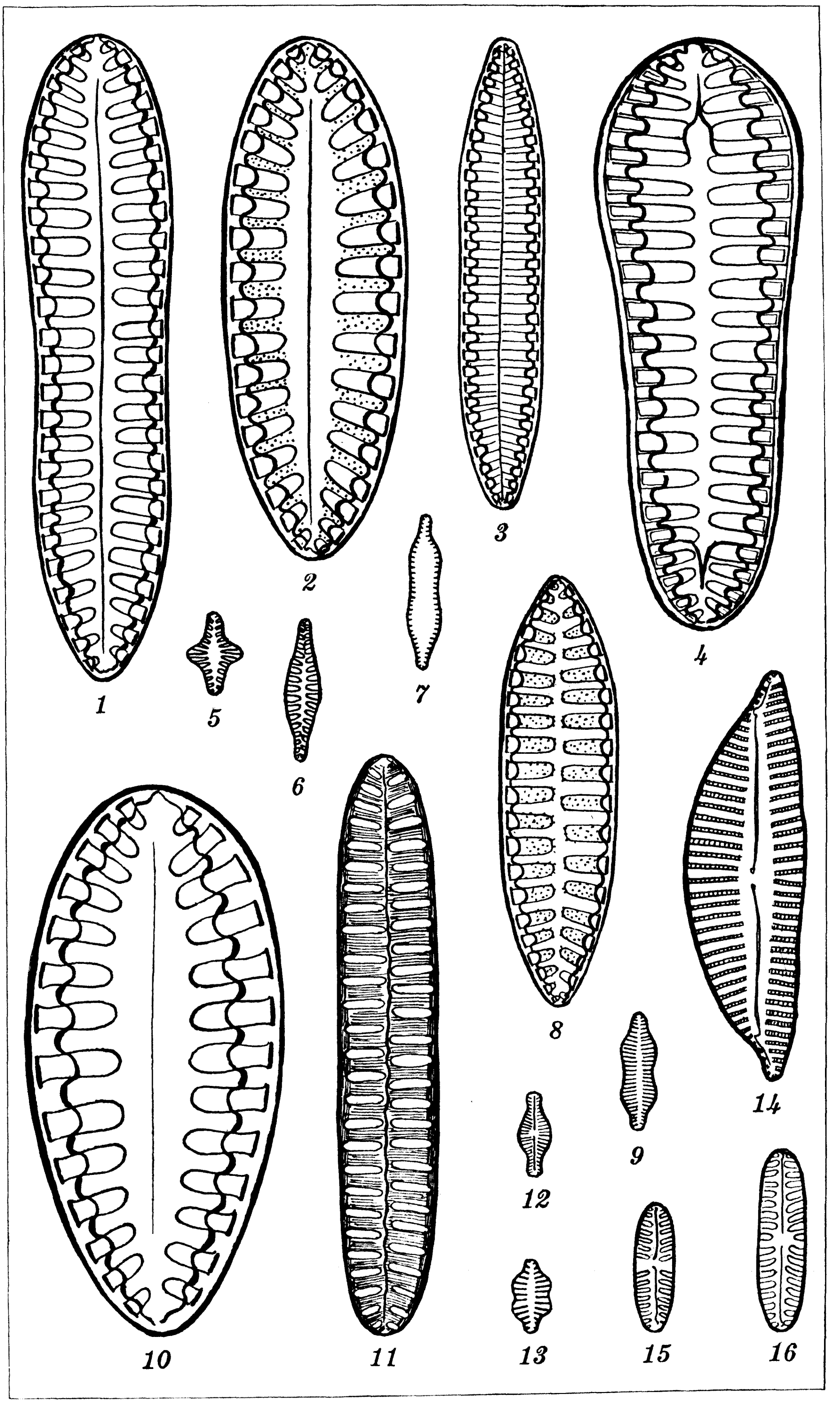


PLATE 16.

OÖCHORISTICA EXCELSA, A NEW REPTILIAN CESTODE

By MARCOS A. TUBANGUI and VICTORIA A. MASILUÑGAN

Of the Bureau of Science, Manila

ONE TEXT FIGURE

Two specimens of a new tapeworm were found in the intestine of a grass lizard, *Mabuia multifasciata.* Unfortunately, the head and neck are lacking in one of the specimens, for which reason a comparative study could not be made of these structures.

According to Meggitt (1934), the genus *Oöchoristica* (Luehe, 1898) includes twenty-five valid species, the other forms that have been described under the genus being either synonyms or members of closely related cestode genera. To these the following have recently been added: *Oöchoristica lygosomæ,* described by Burt (1933) from a lizard, *Lygosoma punctatum,* caught in Colombo, Ceylon; *O. thapari,* described by Johri (1934) from an Indian lizard, *Calotes* sp.; and *O. taborensis,* found by Loewen (1934) in the intestine of a bat in Kansas, United States. Compared with these known species and considering, according to Meggitt, the course of the genital ducts, the extent of the cirrus sac across the proglottis, and the arrangement of the testes as important characters in differentiating between the members of the genus, the Philippine parasite appears to bear the closest resemblance to *O. surinamensis* (Cohn, 1902), *O. fibrata* Meggitt, 1927, and *O. americana* Hardwood, 1932. It may be distinguished, however, from these three species by the smaller dimensions of its body, head, and cirrus pouch, its fewer testes, and the oval shape of the lobes of its ovary.

OÖCHORISTICA EXCELSA sp. nov. Text fig. 1.

Description.—Maximum length about 26 millimeters. Immature and mature segments much wider than long, gravid segments squarish but usually much longer than wide. Extreme measurements of available material gave the following results: Immature segments 0.030 to 0.072 by 0.24 to 0.35, mature segments 0.095 to 0.247 by 0.38 to 0.62, gravid segments 1.9 to 4.7 by 0.55 to 1.1 millimeters. Scolex unarmed, 0.25 millimeter in diameter, separated from the rest of the worm by a very

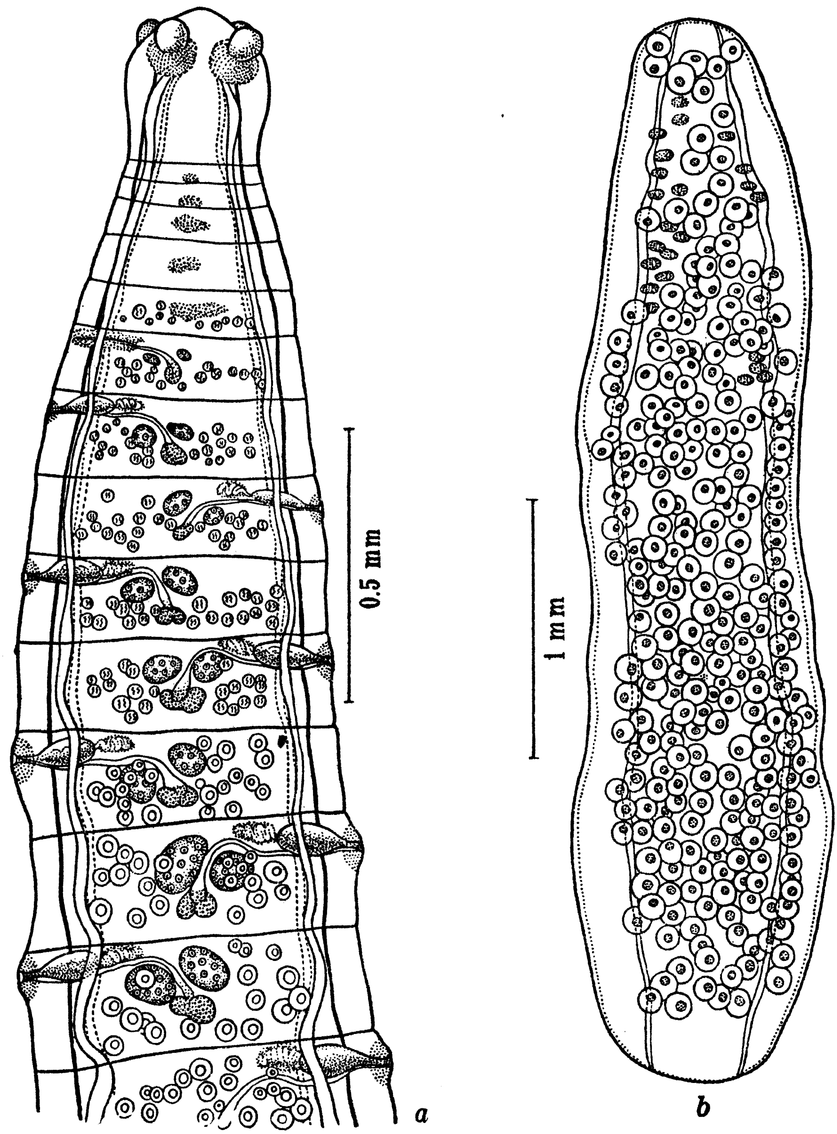


FIG. 1. *Oöchoristica excelsa* sp. nov.; *a*, anterior end of worm showing scolex and mature segments; *b*, a gravid segment.

short neck. Suckers 0.075 to 0.088 millimeter in diameter. Genital pores irregularly alternate, situated at posterior border of first third of lateral margins of mature proglottids; in gravid segments they occur at limit of anterior fourth or fifth of

margins. Genital cloaca absent. Genital ducts pass between principal longitudinal excretory vessels.

Male reproductive organs appear to attain maturity before those of the female genital system. Testes spherical, 23 to 29 in number, 19 to 30 microns in diameter, at posterior half of proglottis and extending anteriorly on both sides of median line to middle level of ovary; they are confined between longitudinal excretory vessels. Cirrus sac oval, 0.107 to 0.123 by 0.046 to 0.057 millimeter in size. In mature segments the cirrus sac extends mesially well past the longitudinal excretory vessels, while in gravid segments it does not pass beyond these vessels. Vas deferens short, in loose coils.

Ovary bilobed, immediately preëquatorial, displaced slightly towards poral side of segment; lobes oval, 0.030 to 0.073 by 0.050 to 0.096 millimeter in size. Vitelline gland median, composed of two wings, 0.053 to 0.084 millimeter across, immediately behind ovary. Shell gland small, between ovary and vitelline gland. Vagina opens into genital pore behind cirrus. A distinct receptaculum seminis present. Uterine sacs are first seen in eleventh or twelfth segment; a fully developed gravid segment contains at least 250 of these sacs or capsules, each inclosing a single ovum. Uterine capsules 84 to 107 microns in diameter, onchospheres 38 to 46 by 30 to 34 microns in size, and the embryonal hooks about 19 microns in length.

Specific diagnosis.—Oöchoristica: Maximum length 26, maximum breadth 1.1 millimeters. Scolex 0.25 millimeter across. Genital pores irregularly alternate, at limit of anterior third of lateral margins of mature segments; in gravid proglottids at limit of anterior fourth or fifth of margins. Genital cloaca absent. Cirrus sac 0.107 to 0.123 by 0.046 to 0.057 millimeter in size, in mature proglottids half-crossing longitudinal excretory vessels, in gravid segments extending only to vessels. Testes 23 to 29 in number, 19 to 30 microns in diameter, reaching anteriorly to middle level of ovary. Uterine capsules 84 to 107 microns in diameter, onchospheres 38 to 46 by 30 to 34 microns in size, embryonal hooks 19 microns in length.

Host.—Grass lizard, *Mabuia multifasciata.*

Location.—Intestine.

Locality.—Los Baños, Laguna Province, Luzon.

Type specimens.—Philippine Bureau of Science parasitological collection, No. 506.

LITERATURE CITED

BURT, D. R. R. Oöchoristica lygosomae sp. nov., a cestode from the lizard Lygosoma punctatum. Spolia Zeylanica 18 (1933) 1–7.

JOHRI, L. N. Report on a collection of cestodes from Lucknow (U. P., India). Rec. Ind. Mus. 36 (1934) 153–177.

LOEWEN, S. L. A new cestode from a bat. Trans. Kansas Acad. Sci. 37 (1934) 257–258.

MEGGITT, F. J. On some tapeworms from the bullsnake (Pityopis sayi), with remarks on the species of the genus Oöchoristica (Cestoda). Journ. Parasit. 20 (1934) 181–189.

ILLUSTRATION

TEXT FIGURE

FIG. 1. *Oöchoristica excelsa* sp. nov.; *a*, anterior end of worm showing scolex and mature segments; *b*, a gravid segment.

DIE STAPHYLINIDEN DER PHILIPPINEN (GATTUNG OXYTELUS)[1]

Von Max Bernhauer

Öffentlicher Notar in Horn, Nieder-Österreich

Übersicht über die philippinischen Arten der Gattung Oxytelus.

1. Erstes Fühlerglied gegen die Spitze nicht erweitert ... 2.
   Erstes Fühlerglied gegen die Spitze keulig erweitert ... 8.
2. Augen fein facettiert: Untergattung *Tanycrærus* ... 7.
   Augen grob facettiert: Untergattung *Caccoporus* ... 3.
3. Halsschild mit deutlichen Längsfurchen ... 4.
   Halsschild fast ohne Andeutung von Furchen. Einfarbig rötlichgelb, glänzend, fast unbehaart. Kopf so breit wie der Halsschild, mit sehr grossen, fast die ganzen Kopfseiten einnehmenden, ziemlich fein facettierten Augen, fein und weitläufig punktiert, ohne deutliche Eindrücke. Halsschild fast so breit wie die Flügeldecken, fast um die Hälfte breiter als lang, nach rückwärts geradlinig, etwas ausgeschweift verengt, längs der Mitte mit einer sehr feinen, undeutlichen Längsfurche, an den Seiten schwach niedergedrückt, fein und weitläufig, an den Seiten etwas dichter punktiert. Flügeldecken etwas länger als der Halsschild, fein und wenig dicht, etwas längsrissig punktiert. Abdomen fast unpunktiert. Länge: 2.5 mm. Manila ... *æquicollis* sp. nov.
4. Die seitlichen Längseindrücke des Halsschildes lang, scharf und tief, die Mittelfurchen ebenfalls sehr tief und scharf. Molukken, Philippinen, Neu-Britanien ... *fallax* Fauv.
   Die seitlichen Längseindrücke des Halsschildes mehr oder minder flach und undeutlich ... 5.
5. Hinterleib mit durchgehender schwarzer Mittellinie, Halsschild ziemlich glänzend. Java ... *ruptus* Fauv.
   Hinterleib ohne schwarzer Mittellinie ... 6.
6. Körper grösser, Halsschild ziemlich matt, dicht längs gerunzelt. Über die indo-malayische Region weit verbreitet ... *nigriceps* Kr.
   Körper kleiner, Halsschild glänzend, ziemlich weitläufig punktiert, kaum längsgestrichelt. Fast über die ganzen Tropen mit Ausnahme des afrikanischen Festlandes verbreitet (*ferrugineus* Kr.). *incisus* Motsch.
7. Körper klein, Färbung tiefschwarz mit hellgelben Flügeldecken, Halsschild an den Seiten ziemlich gleichmässig gerundet, mit abgerundeten Hinterecken. Über den grössten Teil der indo-malayischen und afrikanischen Region und Madagaskar verbreitet ... *micans* Kr.
   Körper grösser, Halsschild rotgelb, nach rückwärts stark und mehr geradlinig verengt, mit sehr tiefen, schwarzen Furchen. *megaceros* var. *flavicollis* Bernh.

[1] 32. Beitrag zur indo-malayischen Staphyliniden-Fauna.

8. Kopf beim Männchen mit zwei Stacheln am Vorderrand. (Untergattung *Boettcherinus* nov.) .... 28.
Kopf beim Männchen am Vorderrand ohne Stacheln........ 9.
9. Rückenfläche der Flügeldecken durch eine kräftige scharfe Längsfalte von den herabgebogenen Seiten begrenzt, Augen klein facettiert. (Untergattung *Emopotylus.*)
Körper ziemlich gross, Halsschild fast mehr als doppelt so breit wie lang. Lebhaft rötlichgelb, der Kopf schwarz, die Flügeldecken geschwärzt, in sehr seltenen Fällen hell, die Tergite an der Basis mehr oder minder schmal geschwärzt, die Fühler rostbraun. Kopf beim Männchen fast so breit wie der Halsschild, beim Weibchen viel schmäler, stark quer, vorn stark eingedrückt, glänzend, hinten kräftig und dicht, beim Männchen längs gestrichelt, beim Weibchen mehr runzelig punktiert, die Schläfen beim Männchen nach rückwarts erweitert, viel länger als die Augen, beim Weibchen viel kürzer, nach hinten nicht erweitert. Fühler gegen die Spitze mässig verdickt, das vierte und fünfte Glied kugelig, die folgenden eine sechsgliedrige Keule bildend, die vorletzten um die Hälfte breiter als lang. Der Halsschild mindestens doppelt so breit wie lang, mit drei tiefen Längsfurchen und einem breiten Seiteneindruck, ziemlich kräftig und ziemlich weitläufig punktiert, glänzend. Flügeldecken etwas länger als der Halsschild, ziemlich stark und mässig dicht, hinten etwas längsrissig punktiert. Hinterleib fast unpunktiert. Länge: 4 bis 5 mm. LUZON, Los Baños. MINDANAO, Surigao und Momungan.
nigripennis sp. nov.
Rückenfläche der Flügeldecken ohne oder nur mit schwacher Begrenzungsfalte. (Untergattung *Anotylus.*) .... 10.
10. Vorderkörper mehr oder minder glänzend und grob skulptiert, Grundfärbung hell .... 11.
Vorderkörper mehr oder minder matt, äusserst fein skulptiert, Grundfärbung meist schwarz .... 23.
11. Halsschild mehr oder minder weitläufig oder nur mässig dicht punktiert .... 12.
Halsschild dicht punktiert oder gestrichelt........ 17.
12. Flügeldecken einfach und sehr weitläufig punktiert. Körper grösser, 3 bis 4 mm........ *bakeri* Bernh.
Flügeldecken weniger weitläufig und kräftig längsgestrichelt .... 13.
13. Körper grösser (3 mm) Kopf glänzend, nicht chagriniert.
nitidifrons Woll.
Körper kleiner (1.5 bis 2.5 mm), Kopf wenigstens beim Männchen teilweise matt chagriniert .... 14.
14. Kopf beim Männchen sehr stark erweitert, zwischen den Augen äussert fein und ganz matt chagriniert ohne deutliche Punktierung, beim Weibchen glänzend, viel schmäler als der Halsschild. Einfarbig rötlichgelb, mit etwas dunklerem Kopf. Fühler ziemlich gestreckt, die vorletzten Glieder schwach quer. Halsschild um mehr als die Hälfte breiter als lang, verkehrt trapezförmig, mit drei tiefen Längsfurchen und je einem breiten Seiteneindruck, ziemlich kräftig und wenig dicht punktiert, glänzend. Flügeldecken etwas länger als der Halsschild, kräftig und dicht längsgerunzelt, wenig glänzend. Länge: 1.5 bis 2.5 mm. MINDORO, Subaan. LUZON, Mount Maquiling, Mount

Isarog, Imugan, Balbalan, Bayombong, Los Baños, Limay, Pagsanjan. MINDANAO, Surigao. BILIRAN .... *hostilis* sp. nov.

Kopf beim Männchen weniger erweitert, zwischen den Augen deutlich punktiert .... 15.

15\. Halsschild namentlich an den Seiten dichter punktiert .... 16.

Halsschild überall sehr weitläufig punktiert. Dem *hostilis* sehr nahe verwandt und ihm in Gestalt und Färbung sehr ähnlich, durch viel weitläufigere Punktierung und besonders im männlichen Geschlecht durch weniger erweiterten und zwischen den Augen nicht matt chagrinierten, sondern ziemlich glänzenden, mässig fein und wenig dicht punktierten Kopf verschieden. Länge: 2.2 mm. LUZON, Pagsanjan. *pagsanjanensis* sp. nov.

16\. Kopf zwischen den Augen matt chagriniert, mässig fein und mässig dicht punktiert, mit starker von der rückwärtigen Querfurche bis zum Stirneindruck gehender Längsfurche, Färbung wie bei den vorhergehenden beiden Arten. Länge: 2.2 mm. LUZON, Imugan. *sulciceps* sp. nov.

Kopf zwischen den Augen wenig chagriniert, wenig fein und ziemlich dicht punktiert, die Stirnfurche nach vorn verkürzt. In der Färbung kaum verschieden. Länge 2.2 mm. LUZON, Bangui. *mixtus* sp. nov.

17\. Flügeldecken grob und dicht, höchstens hinten längsstreifig punktiert. .... 18.

Flügeldecken wenig grob oder fein, bis zur Basis längsstreifig und kielförmig skulptiert .... 19.

18\. Halsschild und Flügeldecken sehr dicht punktiert, wenig glänzend. Rötlichbraun, der Hinterleib heller, Taster und Beine rötlichgelb, Fühler rostbraun. Kopf schmäler als der Halsschild, matt chagriniert, ohne deutliche Punktierung, der scharf begrenzte Stirneindruck spiegelblank. Halsschild um die Hälfte breiter als lang, mit den normalen Eindrücken, grob und sehr dicht längsrunzelig punktiert. Flügeldecken etwas länger als der Halsschild, grob und sehr dicht, teilweise längsrunzelig, an der Basis nahezu einfach punktiert. Länge: 2.5 mm. LUZON, Laguna, ein einziges Exemplar. *fortipennis* sp. nov.

Halsschild und Flügeldecken mässig dicht punktiert, stark glänzend, im übrigen kaum von dem vorigen verschieden. Länge: 2.5 mm. LUZON, Balbalan, ein einziges Exemplar............ *balbalanensis* sp. nov.

19\. Kopf zwischen den Augen ganz matt chagriniert .... 20.

Kopf zwischen den Augen deutlich etwas seidenglänzend .... 21.

20\. Halsschild nicht allzu dicht und stark punktiert, glänzend, Kopf ausserordentlich fein chagriniert, ohne jede weitere Skulptur. Einfarbig rötlichgelb, mit helleren Tastern und Beinen. Der Kopf beim Männchen mässig, beim Weibchen viel schmaler als der Halsschild, die Schläfen beim Männchen so lang, beim Weibchen viel kürzer als der Längsdurchmesser der Augen. Halsschild etwa um die Hälfte breiter als lang, ausser den normalen Eindrücken stark und mässig dicht gerunzelt-punktiert, glänzend. Flügeldecken mässig kräftig und nicht allzu dicht, in langen, schmalen Kiellinien längsgestreift, ziemlich glänzend. Länge: 2.3 bis 2.8 mm. LUZON, Laguna und Imugan .... *sericeiceps* sp. nov.

Halsschild sehr dicht und fein punktiert, wenig glänzend, Kopf namentlich beim Männchen deutlich längsgestrichelt, Körper viel kleiner, Färbung dieselbe. Kopf beim Männchen fast breiter, beim Weibchen mässig schmaler als der Halsschild, die Schläfen beim Männchen fast doppelt so lang, beim Weibchen wenig kürzer als der Längsdurchmesser der Augen. Die Skulptur des Halsschildes und der Flügeldecken ist viel feiner und dichter, die Oberfläche mit geringem Glanze. Länge: 1.5 bis 1.8 mm. LUZON, Los Baños. SAMAR, Catbalogan. *cameroni* sp. nov.

21. Kopf chagriniert, wenig glänzend .... 22.
Kopf ziemlich glänzend, einfach und tief punktiert. Düster rötlichgelb, Kopf und Fühler etwas dunkler. Kopf beim Männchen fast so breit wie der Halsschild, mit langen, parallelen Schläfen, beim Weibchen viel schmäler, mit kurzer Schläfen, Fühler mässig kurz, die vorletzten Fühlerglieder etwa um die Hälfte breiter als lang. Halsschild quer trapezförmig, um ein Drittel breiter als lang, ausser den normalen Eindrücken wenig kräftig und weitläufig, stellenweise fein längsrissig punktiert. Flügeldecken etwas länger als der Halsschild, ziemlich fein und mässig dicht längsrissig punktiert. Länge: 1.2 bis 1.4 mm. LUZON, Los Baños und Bayombong. *modestus* sp. nov.

22. Halsschild ziemlich stark längsgestreift, pechschwarz, die Taster und Beine rötlichgelb, die Fühler bräunlich mit heller Wurzel und Spitze. Kopf viel schmäler als der Halsschild (Weibchen) sehr fein chagriniert, an den Seiten deutlich längsrissig, mit Ausnahme des glänzenden Stirneindruckes wenig glänzend, Augen gross, die Schläfen ziemlich kurz, unmittelbar hinter den Augen in flachem Bogen schräg gegen den Hals verlaufend. Halsschild verkehrt trapezförmig, nicht ganz um die Hälfte breiter als lang, mit scharf rechteckigen Hinterecken, ausser den normalen, ziemlich tiefen Furchen kräftig, gegen die Mitte zu schwächer längsgestreift, ziemlich glänzend. Flügeldecken etwas länger als der Halsschild, ziemlich kräftig und ziemlich dicht längsgestreift, ohne eigentliche Punktierung. Länge: 2 mm. MINDANAO, Surigao. Ein einzelnes Exemplar.............. *aciculatus* sp. nov.
Halsschild ausserordentlich fein längsgestreift, schmutziggelb, mässig glänzend, der Mund und die Beine rötlichgelb, die Fühler bränlich. Kopf beim Weibchen ähnlich wie bei der vorigen Art, jedoch mit stärker gerundeten Schläfen, beim Männchen viel breiter und grösser, fast so breit wie der Halsschild, mit parallelen, langen Schläfen, ausser dem glänzenden Stirneindruck äusserst fein und dicht chagriniert, ziemlich matt. Halsschild um die Hälfte breiter als lang, nach rückwärts mässig verengt, mit stumpfen Hinterecken, ausser den mässig tiefen, normalen Längseindrücken sehr fein und dicht längsgestreift, mässig glänzend. Flügeldecken ziemlich kräftig und ziemlich dicht längsrissig punktiert. Länge: 1.2 bis 2 mm. MINDANAO, Port Banga und Momungan. MINDORO, San Teodoro. SIARGAO, Dapa .... *tenuistrigosus* sp. nov.

23. Halsschildkiele stark glänzend .... *pygmaeus* Kr.
Halsschildkiele nicht oder kaum glänzend.. 24.

24. Kopf neben den Augen mit einer bis zur Einschnürung gehenden Längsfurche .... *latiusculus* Kr.

25. Halsschild um ein Drittel breiter als lang .... 26.
Halsschild um die Hälfte breiter als lang. Rötlichgelb, matt, die Flügeldecken etwas dunkler. Kopf beim Männchen so breit wie der Halsschild, mit langen Schläfen, nach hinten etwas erweitert, äusserst dicht chagriniert, beim Weibchen schmäler als der Halsschild, Schläfen kürzer. Halsschild verkehrt trapezförmig, äusserst dicht, matt chagriniert. Flügeldecken wenig länger als der Halsschild, ebenso dicht wie dieser, aber stärker chagriniert. Länge: 1.5 bis 2 mm. LUZON, Mount Maquiling. MINDORO, San Teodoro .... *luzonicus* sp. nov.
26. Klypeus nicht glänzend, wie der übrige Kopf matt .... *obscurus* Cam.
Klypeus mehr oder minder glänzend .... 27.
27. Körper schwarz bis pechbraun, Flügeldecken gekörnt punktiert. *minutus* Cam.
Körper rötlichgelb, Flügeldecken dicht längsgestrichelt, Fühler, Taster und Beine etwas blasser. Kopf schmäler als der Halsschild (Weibchen) mit Ausnahme des Klypeus matt chagriniert. Halsschild verkehrt trapezförmig, etwas mehr als ein Drittel breiter als lang, matt chagriniert, die drei Halsschildfurchen ziemlich scharf, der Seiteneindruck deutlich. Flügeldecken länger als der Halsschild, dicht und deutlich längsgestreift. Länge: Kaum 1 mm. LUZON, Los Baños, ein einziges Weibchen .... *liliputanus* sp. nov.
28. Vorderkörper matt .... 29.
Vorderkörper mehr oder minder glänzend .... 30.
29. Vorderkörper vollkommen glanzlos, Halsschild ohne Andeutung einer Mittelfurche, die Stacheln am Vorderrand der Stirn beim Männchen an der Spitze nach auswärts geschwungen. Schwarzbraun, die Wurzel der gebräunten Fühler und der Mund dunkler, die Beine heller rötlichgelb. Kopf beim Männchen fast breiter, beim Weibchen schmäler als der Halsschild, beim Männchen nach hinten erweitert, mit langen Schläfen, beim Weibchen wit kurzen, nach rückwarts verengten Schläfen, der Stirneindruck beim Männchen stark, beim Weibchen schwach glänzend. Die Fühler gegen die Spitze stark verdickt, die vorletzten Glieder stark quer, das erste Glied beim Männchen stark verdickt. Halsschild fast so breit wie die Flügeldecken, um die Hälfte breiter als lang, nach rückwärts stark verengt, die drei Mittelfurchen kaum angedeutet, die seitlichen Eindrücke deutlich. Die Flügeldecken matt chagriniert, bei gewisser Ansicht mit rötlichem Kupferschimmer, wenig länger als der Halsschild. Hinterleib glänzend, nur undeutlich punktiert. Länge: 1.5 bis 1.8 mm. LUZON, Los Baños und Mount Maquiling. MINDORO, San Teodoro. *planaticollis* sp. nov.
Vorderkörper mit sehr schwachem, aber immerhin wahrnehmbarem Fettschimmer, Halsschild mit deutlicher Mittelfurche, die Stacheln am Vorderrand der Stirn beim Männchen gerade. Färbung etwas weniger dunkel, die Flügeldecken an der Basis rötlichgelb. Kopf beim Männchen nicht breiter als der Halsschild, nach hinten kaum erweitert, beim Weibchen beträchtlich schmäler als der Halsschild mit kurzen Schläfen. Fühler kaum verschieden. Stirneindruck auch beim Weibchen deutlich glänzend und mit einem Höckerchen versehen. Halsschild fast noch kürzer, mit scharfen Hinterecken, vor

diesen unmerklich gebuchtet, die seitlichen Mittelfurchen gut angedeutet. Flügeldecken ohne Kupferglanz. Länge: 1 bis 2 mm. LUZON, Los Baños. MINDORO, San Teodoro.............. *cornutus* sp. nov.

30. Halsschild stark glänzend, nicht oder nur weitläufig längsgestrichelt. 31.

Halsschild nur mässig glänzend, ziemlich dicht längsgestrichelt. Pechschwarz, die Fühler und Taster bräunlich, die Beine hellgelb beim Männchen: Kopf so breit wie der Halsschild, um ein Drittel breiter als lang, nach rückwärts backenartig erweitert, der Eindruck im vorderen Teil, sowie eine Mittelzone auf dem erhobenen Teil geglättet, stark glänzend, die Seiten neben den Augen stark chagriniert und hinter den Augen dicht längsgerunzelt. Die Fühler sind mässig verdickt, bis zum Hinterrand des Halsschildes reichend, die vorletzten Glieder um die Hälfte breiter als lang. Halsschild um die Hälfte breiter als lang, nach rückwärts stark verengt, vor den scharfen Hinterecken tief ausgeschweift, in der Mitte mit drei starken Furchen, seitlich mit einem flachen Eindruck, dicht längsrissig skulptiert, nur die beiden Kiele zwischen den Furchen geglättet. Flügeldecken länger als der Halsschild, stark quer, sehr dicht und kräftig längsgestreift, wie der Halsschild mässig glänzend. Hinterleib stark glänzend, kaum punktiert. Länge: 2.1 bis 2.5 mm. MINDANAO, Surigao .... *militaris* sp. nov.

31. Halsschild an den Seiten weitläufig längsgestrichelt und mit einem ziemlich starken Eindruck. Schmutzig rötlichgelb, glänzend, der Hinterleib dunkler, die Wurzel der bräunlichen Fühler, die Taster und Beine blassgelb. Kopf so breit wie der Halsschild, mässig breiter als lang, hinter den Augen gerade, unmerklich erweitert, an den Seiten matt chagriniert, längs der breiten Mittelzone und der Stirneindruck geglättet. Fühler kurz, die vorletzten Glieder fast doppelt so breit wie lang. Halsschild fast so breit wie die Flügeldecken, stark quer, nach rückwärts stark verengt, mit geradlinigen Seiten und stumpfwinkeligen Hinterecken, mit tiefer Mittelfurche, vor der Basis mit zwei kleinen Furchen, seitlich fein und wenig dicht längsgestrichelt. Flügeldecken länger als der Halsschild, wenig dicht längsgestrichelt, glänzend. Hinterleib kaum punktiert. Länge: 1.5 mm. MINDORO, San Teodoro, ein einziges Männchen. *bispinosus* sp. nov.

Halsschild an den Seiten ohne Strichelung. Dunkel rötlichgelb bis pechfarben, glänzend, die Fühlerwurzel, die Taster und Beine blassgelb. Kopf beim Männchen nicht oder kaum schmäler als der Halsschild, mit parallelen, den Augendurchmesser an Länge überragenden Schläfen, beim Weibchen viel schmäler als der Halsschild, nach rückwärts verengt, mit kurzen Schläfen, glänzend glatt, nur mit einzelnen Punkten, beim Männchen hinter den Augen äusserst fein chagriniert und zwischen den Augen ungemein fein, schwer sichtbar längsgestrichelt. Stirn beim Männchen nicht wie bei den vorherigen Arten mit zwei langen, geraden Stacheln an den Seiten, sondern mit zwei scharfen, dicht aneinanderliegenden Zähnchen in der Mitte des Vorderrandes. Fühler wie bei der vorigen Art. Halsschild beim Männchen stark, beim Weibchen mässig quer, verkehrt trapezförmig mit

stumpf verrundeten Hinterecken, längs der Mitte mit einer in der Regel in der hinteren Hälfte verkürzten, bisweilen jedoch durchgehenden tiefen Längsfurche, sonst fast ohne jede Skulptur, stark glänzend, ohne deutlichen Seiteneindruck. Flügeldecken etwas länger als der Halsschild, glänzend glatt, fast ohne jede Andeutung einer Punktierung. Von *Oxytelus uncifer* Fauv., dem die Art sehr nahe steht, unterscheidet sie sich durch das Fehlen der seitlichen Mittelfurchen und der Seitengruben am Halsschild und den Mangel der Flügeldeckenpunktierung. Länge: 2 bis 2.5 mm. LUZON, Los Baños und Mount Banahao. MINDANAO, Momungan und Port Banga.

bidentatus sp. nov.

NEW LONGICORN BEETLES FROM FORMOSA, III (COLEOPTERA: CERAMBYCIDÆ)

By J. LINSLEY GRESSITT

Of the University of California, Berkeley

ONE PLATE

The following descriptions are based on material collected by the author during two trips to Formosa, in 1932 and 1934, respectively. Two of the forms herein described are interesting as being subspecifically related to more northern forms, from north-central China and the northern Loochoo Islands, respectively. Several of the other new species represent various new genera, some of which are apparently without very close affinities, and others have tropical Oriental relationships. The types are deposited in the United States National Museum, Washington, D. C., and in the California Academy of Sciences, San Francisco, those in the latter being unnumbered unique types on loan deposit. Types previously designated by the writer as "in the author's collection" are similarly deposited in the collection of the California Academy of Sciences. The author is indebted to Dr. E. C. Van Dyke and Mr. E. P. Van Duzee for use of material in the California Academy of Sciences.

CERAMBYCINI

Cerambyx minutum Gressitt [1] is a synonym of *Dymasius kisanus* Matsushita,[2] having been published one day later than the latter name. The type locality of *C. minutum*, "Kamikochi, Japan," is erroneous, and should have been Kisan, Formosa, the same as for *D. kisanus*. The author's specimen was received in 1932 from Y. Yano, the collector of Matsushita's material, but it was in an envelope with lepturids from Kamikochi. The carelessness of the above collector is further evidenced by the writer having seen lepturids from Kamikochi in collections sent to this country labeled as from Kisan, Formosa.

[1] Philip. Journ. Sci. 55: 379, published March 8, 1935.

[2] Trans. Nat. Hist. Soc. Formosa 26: 540, published March 7, 1935.

CALLICHROMINI

Genus AROMIA Serville, 1833

AROMIA FALDERMANNI subsp. INSULARIS Gressitt subsp. nov. Plate 1, fig. 1.

Large, handsome; body largely iridescent green or violet; head violet-black, greenish on frons and occiput; mandibles blue laterally; antennæ dull blackish apically, scape shiny lavender, blue, or green, the following three segments iridescent purplish blue; prothorax purplish blue with a large orange area on each side reaching from apex to near base and to two pairs of tubercles on each side of middle of disc, greenish and coppery below, the process bluish black; scutellum deep blue or green; elytra variable, greenish basally, remainder greenish purplish brown; legs purplish blue or greenish, tarsi testaceous; ventral surface dark greenish with purplish tinges.

Head broad; antennal supports high and close; frons small; genæ large; surface minutely punctulate, irregularly clothed with dark hairs. Antennæ slightly longer than body in male, three-fourths as long in female; third segment longest; fourth to tenth decreasing slightly, acute externally at apices. Prothorax broad, with a thick tubercle at each side, and six on disc: One behind middle of anterior margin, a pair near center and three posteriorly, outer posterior ones highest, subtransverse; surface with erect dark hairs, particularly on the purple area. Scutellum elongate-triangular, grooved. Elytra slightly narrowed, rounded apically, and microgranulose-punctate. Hind tibiæ compressed and sinuate; first segment of hind tarsus not quite as long as remaining united. Length, 34 to 46 millimeters; breadth, 9.5 to 12.5.

Holotype, male, No. 51424, United States National Museum; Bukai, central Formosa, altitude 1,400 meters, June 16, 1934; allotype, female, Hassenzan, Formosa, altitude 1,500 meters, June 24, 1934; paratopotype, male, June 15, five paratypes, Hori, Formosa, altitude 600 meters, June, 1934; and one paratype, male, Hinokiyama, northern Formosa, altitude 1,600 meters, July 16, 1934 (*Y. Izumi*) in the author's collection; one paratype, Hori, in the California Academy of Sciences.

Differs from *Aromia faldermanni* Saund.,[3] from northern China, as which the present form has already been recorded from Formosa, in being larger, in having the antennæ entirely dark, instead of orange on the latter seven segments, and in

[3] Trans. Ent. Soc. London II 2 4 (1850) 111, pl. 4, fig. 7.

having the orange portion of the prothorax separated into two spots, with the central portion violet, instead of extending completely across the dorsal surface. In *insularis* the vertex is more deeply, and narrowly, grooved, the prothorax is more constricted before the lateral tubercles, the posterior tubercle of each side of the disc is more pronounced, and the scutellum is narrower and more deeply grooved. Specimens from northern Formosa (Hinokiyama) differ slightly in having the scape and anterior pairs of legs more greenish than purple, and the elytra largely greenish; but the iridescent coloration in these forms is exceedingly variable.

Genus CHLORIDOLUM Thomson, 1864

CHLORIDOLUM LOOCHOOANUM subsp. TAIWANUM Gressitt subsp. nov. Plate 1, fig. 2.

Moderately small; elegant, bright green; antennæ violet-blue; legs steel-blue; pronotum bluish on disc; scutellum shiny, slightly bluish green; elytra frosted green, lighter on shoulders and along basal portion of suture, slightly darker on disc; mandibles black at apices; palpi testaceous, with apical segments of both pairs brown except at apex; ventral surface bright green, finely clothed with short silvery pile.

Head moderately punctured on occiput and behind eyes, more finely and sparsely on vertex, frons, and genæ, and finely and densely on mandibles; gular area transversely, and subocular areas sublongitudinally, corrugated; frons and vertex narrowly midlongitudinally sulcate to between eyes. Antennæ two and one-third times as long as body in male, one-third longer in female; scape thick, subacute ectoapically, grossly punctured, subobliquely grooved externally; fourth segment slightly shorter than third, last longest. Prothorax longer than breadth at base, laterally armed slightly behind middle with a blunt tubercle with a short, acute tip; disc transversely striolate near apex and base, transversely or obliquely so at sides, and longitudinally in middle, with the outer longitudinal striolæ diverging and incompletely meeting the lateral ones in a blue, punctured area on each side of center; underside transversely corrugated anteriorly, subvermiculose punctate posteriorly; area around lateral tubercles smooth. Scutellum triangular, subacute behind, longitudinally grooved, nearly impunctate. Elytra narrowed posteriorly; apices narrowed and obtusely angulate near suture; surface granulose, except along suture near scutellum where it is finely, transversely corrugated and shiny. Legs and ventral surface finely punctured. Length, 14.5 to 18 millimeters; breadth, 3 to 4.

Holotype, male, No. 51425, United States National Museum; Bukai, Formosa, altitude 1,400 meters, June 12, 1934; allotopotype, female, and six paratopotypes in the author's collection; one paratopotype in the California Academy of Sciences; all taken by the author, June 12 and 14.

Differs from *C. loochooanum* Gressitt,[4] from Amami-Oshima Island, in being smaller, in having the elytra green instead of bluish, only the central part of the disc of prothorax blue, the labrum green instead of black, the vertex lacking ridges and striolæ parallel to the median groove, the scutellum narrower and longitudinally grooved, the elytra more strongly narrowed and more acute apically, and the abdomen smoother.

MOLORCHINI

Genus KURARUA Gressitt novum

Narrow, elytra narrowed and slightly outwardly curved posteriorly, slightly abbreviated; antennæ with third segment minute, posterior seven segments long and thickened; eyes finely faceted and emarginate; anterior coxæ subconical, their cavities subacute externally, and apparently open behind; middle coxal cavities very narrowly open externally.

Head longer than broad, slightly broader than prothorax; neck narrowest immediately behind the eyes; eyes minutely faceted, prominent, very narrowly constricted behind the antennal insertions; the antennal supports broad, rounded; the vertex narrow, medially sulcate to middle of frons, with a row of punctures on each side; frons short and broad, an impunctate area at middle of apical margin and a pit at each side near clypeus; clypeus very broad basally, basal margin rather concave, apical margin slightly so; labrum transverse, very short; mandibles moderate, apices acute, sides densely punctate; palpi short, the last segment subelliptical; genæ short. Antennæ (male?) one-third longer than body, moderately thick, except for second to fourth segments; scape three times as long as broad, arched; second segment minute, longer than broad, thickened apically; third segment minute, no thicker than, and but twice as long as, second; fourth segment half again as long as third, subequal to scape; fifth segment large, as long as two preceding combined, apex broadened, external angle subacute; following segments similar and progressively slightly longer; apical segment longest, with the apical fifth narrowed; first four segments

[4] Pan-Pacific Entomol. 9: 163.

slightly shiny and punctate, following segments dull, covered with minute, recumbent, bristlelike hairs. Prothorax subcylindrical, two-fifths again as long as broad, narrower than elytra; base as broad as middle; apex slightly narrower; disk fairly even, moderately sparsely punctate. Scutellum minute and narrow, apical portion concave. Elytra narrow, broadest basally, constricted antemedially, slightly narrowed posteriorly, not quite reaching apex of abdomen; apices narrowed externally and rounded; surface with fairly dense shallow punctures. Anterior coxal cavities slightly rounded, broader than long, subacute externally, apparently open behind, moderately separated, the intercoxal process expanded and rounded posteriorly; middle coxal cavities extremely narrowly open to epimera; intercoxal process of mesosternum broad, reaching just beyond middle acetabula, its apex concave, receiving process of metasternum; metasternum swollen and fairly densely punctured; metepisternum large, swollen posteriorly. Abdomen with first segment nearly as long as following two combined; second to last segments subequal, the fourth shortest. Legs fine, femora pedunculate and apically clavate; hind tibiæ slightly arched; first tarsal segments slightly shorter than following two segments combined in anterior pair, subequal in second pair, and only slightly longer in hind pair.

Genotype.—*Kurarua constrictipennis* Gressitt sp. nov.

Range.—Formosa (southern tip).

This genus is doubtfully placed in the Molorchini because the anterior coxal cavities are seemingly opened behind and the middle coxal cavities are very narrowly open exteriorly. It differs from most of the genera in the tribe in the very short third and fourth antennal segments, the smooth prothorax and long elytra. It differs from *Kunbir* in its much narrower form, longer and different antennæ and prothorax, and more suddenly, and more briefly, clavate hind femora.

KURARUA CONSTRICTIPENNIS Gressitt sp. nov. Plate 1, fig. 5.

Black, prothorax (except anterior margin) and forelegs red; elytra reddish brown basally and grayish brown on apical two-thirds. Body clothed with reddish brown hairs above and whitish hairs below.

Moderately small, narrow; prothorax long and plain; elytra constricted antemedially, narrower and divergent posteriorly, not quite reaching apex of abdomen; antennæ slightly longer than body, third segment minute, only twice as long as second, and two-thirds as long as fourth, the latter equal to scape, fol-

lowing segments long and thick, slightly flattened; legs fine, femora pedunculate and clavate, hind pair barely so for apical third. Length, 9.2 millimeters; breadth, 1.8.

Holotype, male (?), California Academy of Sciences; Kuraru, Koshun, near South Cape, Formosa, altitude 140 meters, April 10, 1932, taken by the author.

This species superficially resembles *Cleomenida setigera* Schw. in appearance, because of its narrow form, red thorax, and clavate femora, but is easily distinguished by its peculiar antennæ, more cylindrical prothorax, and narrowed elytra.

Genus MERIONŒDA Pascoe, 1858

Matsushita[5] has synonymized *Merionœda uraiensis* Kano[6] with *M. formosana* Heller[7] and Mitono[8] has followed him. These species, however, are quite distinct. The two may be distinguished as follows:

Eighth and ninth antennal segments one-fourth as broad as long; middle femora clavate for less than apical half; hind femora clavate for only apical third, the club narrower than head; tibial spines inclined. *M. uraiensis* Kano (fig. 6).

Eighth and ninth antennal segments half as broad as long; middle femora clavate for their apical half; hind femora clavate for nearly their apical half, the club as broad as the head; tibial spine subperpendicular .... *M. formosana* Heller (fig. 7).

CLYTINI

Genus XYLOTRECHUS Chevrolat, 1860

XYLOTRECHUS RUFONOTATUS Gressitt sp. nov. Plate 1, fig. 9.

Moderately small, narrow, attenuated posteriorly; body black, except for an orange-red pronotal spot centered slightly before middle of disc; surface densely clothed above with green pile, paler on scutellum, and below with greenish gray, paler at the sides; antennæ basally with sparse, fine, greenish hairs, apically with microscopic recumbent hairs; legs sparsely clothed with suberect, and some longer erect, pale hairs.

Head abbreviated below; surface granulose punctate, with some large punctures below eyes; vertex and frons with a pair of approximate carinæ, converging at each end, on middle of vertex, and lower part of frons; frons narrow, subparallel, very slightly narrowed in middle, lateral carinæ obscure; eyes

[5] Journ. Fac. Agr. Hokkaido Imp. Univ. 34 2 (1933) 229.

[6] Ins. Matsumuriana 5 (1930) 43, fig. 1.

[7] Ent. Blätt. 20 1 (1924) 32.

[8] Mushi 8 1 (1935) 53.

inverted comma-shaped; palpi fine, apical segments twice as long as broad, rounded-truncate, not broadened, apically. Antennæ (female) short, fine, thickened apically; scape over twice as long as second segment and slightly longer than third; fourth and fifth subequal, each slightly shorter than third; following decreasing; tenth hardly longer than its diameter. Prothorax longer than broad, subcylindrical, only slightly swollen at sides; apex nearly as broad as base; disc somewhat raised postmedially, surface densely and fairly heavily punctured, some very large shallow punctures at sides. Scutellum rounded, less than twice as broad as long. Elytra slightly broader than prothorax, not quite twice as long as head and prothorax united, gradually narrowed posteriorly; apices subtransversely truncate, a very short tooth at sutural angle; surface densely and finely punctured. Metepisternum very narrow, apparently broader posteriorly. Legs with femora only slightly swollen; middle femora most heavily punctured; hind femora slightly exceeding elytral apices; first segment of hind tarsus two and one-half times as long as following two united. Length, 11.5 millimeters; breadth, 2.8.

Holotype, female, a unique, California Academy of Sciences; Hassenzan, Formosa, altitude 1,800 meters, June 21, 1932; taken by the author.

Differs from *X. cinerascens* Matsushita in its smaller size, more parallel and less prominently carinate frons, the two sides of the narrowly elliptic carinæ very close, the prothorax more cylindrical, the scutellum narrower, and the first segment of hind tarsus relatively shorter.

Genus PERISSUS Chevrolat, 1863

PERISSUS GRISEUS Gressitt sp. nov. Plate 1, fig. 8.

Small, abbreviated, subparallel; body black, fairly well clothed with pale greenish gray pubescence, whitish on sides of hind margin of prothorax and undersurface of body, where it is denser on sides of meso- and metathorax; body also with many erect pale hairs, except on tarsi and posterior three-fourths of elytra; antennæ with some moderate hairs on scape and a few projecting ones on inner side of following four segments, besides very fine pubescence covering their entire surface.

Head wider than high in front; finely punctured, with some large punctures on occiput and genæ; antennal insertions moderately distant, hardly raised; vertex plain; eyes inverted comma-shaped, deeply constricted; frons nearly as broad as long;

clypeus glabrous apically, apical palpal segments subtransversely truncate. Antennæ (female) hardly over half body length, somewhat thickened apically; scape as long as second and third segments combined; fourth shorter than third, equal to following; latter few, slightly shorter. Prothorax subcylindrical, no longer than broad, slightly broader at apex than base, slightly swollen at sides; granulose-punctate above. Scutellum short, broad, and rounded. Elytra twice as long as head and prothorax united, broader than prothorax, slightly narrowed posteriorly, separately narrowed and subobliquely truncate at apices; surface minutely granulose-punctate. Legs fine; hind femora and tibiæ sinuate, the femora reaching just beyond elytral apices; first segment of hind tarsus barely twice as long as following two segments united. Length, 8 millimeters; breadth, 21.

Holotype, female, a unique, California Academy of Sciences; Taiheizan, Formosa, altitude 1,600 meters, May 10, 1932; taken by the author.

Differs from *P. kankauensis* Schwarzer and the other species of the genus in lacking spots or fasciæ. The head is very short in front, the prothorax short and the scutellum broad.

Genus RAPHUMA Pascoe, 1858

RAPHUMA NOTABILOIDES Gressitt sp. nov. Plate 1, fig. 4.

Large, cylindrical, subparallel; body black, densely clothed with green or gray pubescence, paler beneath and nearly white at sides, marked with black as follows: A transverse suboval black spot on each side of middle of disc of prothorax, elytra with the external margins narrowly so for most of their length, each with a straight longitudinal stripe from humerus to end of first third, a line curving out from behind scutellum, extending posteriorly, then transversely outward, joining end of humeral stripe, next a fairly large irregular median spot, touching margin but not suture, and finally a large, free, subcircular spot, one-fourth from apex; antennæ clothed with fine, adpressed, greenish gray hairs; some suberect brownish hairs on underside of third and fourth segments; legs with the fine hairs goldish on tarsi, some brownish spinelike hairs on undersides of femora and tibiæ.

Head strongly punctured on either side of occiput and below eyes; eyes large, distant; frons slightly longer than broad, narrowed basally. Antennæ five-sixths as long as body in male, four-fifths in female; third segment longer than scape; fifth to seventh subequal, each longer than fourth and shorter than

third; remaining shorter; seventh to tenth broadened externally at apices. Prothorax broadest behind middle, narrowed apically; surface finely granulose. Scutellum rounded behind. Elytra slightly broader than prothorax, less than twice as long as anterior part of body; apices subobliquely truncate, dentate at both angles. Legs fairly fine; hind tarsi with first segment twice as long as following two united. Length, 17 to 20 millimeters; breadth, 4 to 4.5.

Holotype, male, No. 51426, United States National Museum; Sakahen, eastern Formosa (southwest of Karenko), altitude 1,350 meters, July 13, 1934, two paratopotypes and a female doubtfully referred to this species, Hassenzan, Formosa, altitude 1,400 meters, June 23, 1934, in the author's collection; all taken by the author.

This species is very similar in size and markings to *Chlorophorus notabilis* Pascoe, and quite probably represents the form recorded from Formosa as that species. It differs from the latter in having the antennæ much finer, with the third segment longer than the first, the pronotum smoother, and the legs much finer, with the first tarsal segment much longer. Differs from *Raphuma virens* Matsushita in its much larger size, more sulphurous coloration, more swollen prothoracic disc, and relatively longer third antennal segment and first hind tarsal segment. One of the paratopotypes is gray instead of yellowish green, with the markings less distinct. The specimen from Hassenzan is entirely gray.

Genus DEMONAX Thomson, 1860

DEMONAX MATSUSHITAI Gressitt sp. nov. Plate 1, fig. 10.

Small, narrow, parallel; black, clothed with gray pubescence; elytra with three pairs of dull black fasciæ, the first consisting of a narrow oblique line from suture just behind scutellum to middle of disc, one-fifth from base, and a curved humeral line which nearly meets the former at its apex, second a moderately broad suboblique band slightly before middle, reaching from suture to margin, narrower anteriorly near suture, third transverse, wide, one-fourth from the apex, slightly constricted at the suture, all the bands with a few intermixed gray hairs and their margins indefinite, scutellum and undersides of pro- and mesothorax whitish gray; some suberect pale hairs on legs and undersurfaces of basal antennal segments and apices of following segments.

Head small, as deep as wide; occiput with some large punctures at sides; eyes distant, deeply emarginate; vertex concave; antennal supports subacute internally; frons longer than broad, broader apically. Antennæ nearly as long as body in male, reaching to last quarter of elytra in female; scape not swollen apically, twice as long as second segment; third nearly half again as long as scape and fourth; fifth longer than fourth and following; third and fourth each with an apical spine one-fourth as long as the following segment, that of the fourth the longer. Prothorax one-fourth longer than broad, and very briefly constricted at apex and base; sides moderately swollen; surface shallowly reticulate-punctate with a few deeper punctures posterolaterally. Scutellum narrowly rounded behind. Elytra slightly broader than prothorax, parallel; apices transversely subsinuate-truncate, external angles minutely toothed. Legs fine; hind femora hardly swollen; hind tarsi shorter than tibiæ, first segment nearly twice as long as remaining united. Length, 8.5 millimeters.

Holotype, female, No. 51427, United States National Museum; Hassenzan, Formosa, altitude 1,800 meters, June 24, 1934; and paratopotype, male, in the author's collection, taken the same day.

Differs from *D. sauteri* Matsushita in its slightly larger size, more briefly spined third and fourth antennal segments, and narrower elytral bands, the first extending obliquely from behind scutellum beside another on humerus. Named in honor of Mr. Masaki Matsushita, of Toyohara.

Genus CHLOROPHORUS Chevrolat, 1863

CHLOROPHORUS DEMONACOIDES Gressitt sp. nov. Plate 1, fig. 11.

Laterally compressed, slightly narrowed behind; body black, orange at either side of scutellum, largely clothed with pubescence: head and antennæ sparsely clothed with gray; prothorax largely clothed with grayish green, greenish yellow at each side of basal margin and greenish white beneath; scutellum densely clothed with pale yellow; elytra black, slightly yellowish on basal margin and crossed by fasciæ of greenish yellow, the first extending obliquely from suture slightly behind scutellum to one-third from base, where it turns exteriorly and somewhat anteriorly, not reaching margin, the second transverse, two-thirds from base, broad at suture, narrowing laterally, not

reaching margins, its hind margin straight, the third an oblique apical spot bounded by a line from suture, halfway between second band and apex, to external apical angle, black portions with some adpressed bronzy hairs visible in certain lights; ventral surface grayish below and yellowish at sides; legs moderately clothed with reclining, and a few erect, hairs; some erect pale hairs on head, underside and bases of prothorax, and elytra; antennæ with some internal hairs fused to form false, subapical spines on most of the segments.

Head deep, hardly broader than apex of prothorax, heavily punctured, a few larger and shallower punctures on sides of occiput; antennal insertions distant; frons twice as high as wide, slightly broader apically, a low median carina extending most of its length; genæ fairly long; apical palpal segments broadened and subobliquely truncate apically. Antennæ (female) fine, just over half as long as body; scape small, three times as long as second segment, equal to third; fifth just longer than fourth, shorter than third; remaining shorter than fourth, successively diminishing in length. Prothorax one-fourth longer than broad, hardly narrower at apex than at base, only slightly swollen at sides; surface granulose. Scutellum broadly scutiform. Elytra not quite twice as long as head and prothorax united, slightly broader than prothorax, moderately narrowed posteriorly; transversely subsinuate-truncate apically; base swollen in middle; surface finely punctate. Ventral surface fairly densely and fine-punctured; visible portion of metepisternum hardly broader anteriorly than posteriorly. Legs fairly long, the hind femora extending one-fifth their length beyond elytral apices; middle femora very heavily punctured; hind tarsi with first segment nearly half again as long as remaining united. Length, 12 millimeters; breadth, 3.

Holotype, female, a unique, California Academy of Sciences; Suisha, by Lake Candidius, central Formosa, altitude 750 meters, May 31, 1934.

This species is not closely related to any other species of the genus known to me. It differs structurally from *C. signaticollis* Chevr. in having the head longer, the antennæ finer, more distantly inserted, and with false subapical spines, the prothorax narrower, the scutellum smaller and the hind legs longer; it is very similar in markings to large specimens of *Perissus kankauensis* Schwarzer. Possibly this species should be placed in

Demonax, because the antennal insertions are rather distant, but the spines on the inner sides of antennal segments are composed of groups of hairs instead of extensions of the segments, and furthermore, the third antennal segment is not longer than the scape.

CHLOROPHORUS MIWAI Gressitt sp. nov. Plate 1, fig. 12.

Cylindrical, parallel; black, largely clothed with dense green pubescence; head and antennæ green; prothorax green, with a black spot on each side, and a wide, inverted Y-shaped black marking on disc; scutellum green; elytra green, marked with three sets of fasciæ: The first a zerolike mark on basal portion, not touching suture, barely touching base, and with a short extension along external margin; the second a wide, transverse band at middle, nearly straight behind, and extending anteriorly some distance along suture, another anterior extension joining hind part of zerolike mark at side; the last a large, squarish spot in last third, free from suture and apex, but touching margin; ventral surface clothed with paler green, nearly white on the pleura; legs sparsely clothed with grayish green.

Head higher than wide; frons squarish; eyes inverted comma-shaped; antennal insertions fairly close; occiput heavily punctured on sides. Antennæ (female) slightly more than half as long as body; scape slightly arched, barely longer than third segment; fourth slightly shorter than third; following gradually decreasing; most of the segments with a row of fine setæ below. Prothorax subglobular, slightly longer than broad, narrower at apex than base. Scutellum slightly narrowed, rounded at apex. Elytra fairly long, slightly narrowed; apices obliquely truncate; hardly toothed at either angle. Legs fairly fine; hind tibiæ fairly prominently spined internally at apex; hind tarsi with first segment as long as remaining united. Length, 15 to 15.5 millimeters; breadth, 3.6.

Holotype, female, United States National Museum; Rarasan, northern Formosa, altitude 1,750 meters, July 23, 1934; paratype, female, in the author's collection, Hori, Formosa, July, 1934; paratype, male, Tai Kwong, Lam Mo district, Hunan Province, China, July 26 to 28, 1934 (F. K. To), in the collection of the Lingnan Natural History Survey and Museum, Canton.

Very similar to *C. varius*, of Europe, and *C. dubius* Matsushita, of Formosa, differing from both in having the elytra longer, the

pubescence green instead of yellowish gray or whitish gray, the discal marking of prothorax different, and other characters.

STENASPINI

Genus BUNOTHORAX Gressitt novum

Body strongly compressed dorsoventrally, antennæ with basal segments tufted; prothorax 11-noded; elytra tricarinate; legs short.

Head abbreviated anteriorly; frons short, vertical; vertex broad, concave, grooved medially; occiput smooth, impunctate; eyes deeply constricted, moderately finely faceted, closely approaching mandibles; genæ minute; palpi short, apical segments compressed, truncate apically. Antennæ (male) half again as long as body, first six segments heavily clothed with long black bristles on apical half, following segments with only a few hairs; scape strongly thickened, shorter than third segment; second longer than broad; third and fourth equal, each slightly shorter than fifth to tenth, which are subequal; last twice as long as third; fourth to ninth subangulate externally at apices. Prothorax nearly twice as broad as long; disc with nine more or less rounded tubercles, one at each side near anterior margin, a pair just before middle, one behind center and two at each side near hind margin; each side also with a strong, blunt tubercle; some large, irregular punctures between, or on sides of, tubercles; surface furnished with long black bristles, as on head. Scutellum equilaterally triangular, subacute, concave basally. Elytra separately produced anteriorly at middle of base; narrow basally, hardly broader than prothorax, very slightly broadened posteriorly, rounded apically; disc with three strongly raised lines, another weaker one between outer two; surface densely and grossly punctate, reticulate, glabrous, a few short black hairs along posterior portions of outer margin. Prosternal process rounded, prominent; mesosternal process narrow, squarish in lateral outline, slightly more prominent anteriorly; middle coxal cavities open externally. Legs short; first segment of hind tarsi less than twice length of second.

Genotype.—*Sternoplistes takasagoensis* Kano.

Range.—Formosa.

This genus differs from *Sternoplistes* Guer. in having a much flatter body, shorter, tuberculate prothorax, plumed antennæ, more strongly carinate and punctate, and more glabrous, elytra, longer pro- and mesosternal tubercles, and shorter legs.

BUNOTHORAX TAKASAGOENSIS (Kano). Plate 1, fig. 3.

Sternoplistes takasagoensis KANO, Kontyu (Tokyo) 6 (1933) 278.

Body black, elytra bright red; basal antennal segments with tufts of posteriorly directed black bristles; head and prothorax with erect black bristles; prothorax shiny, with eleven rounded tubercles; elytra nearly naked, strongly punctured and ribbed. Length, 13 to 16 millimeters.

Distribution.—Formosa, Arisan (type locality); Taiheizan, a male in the author's collection, June, 1934.

MESOSINI

Genus SAIMIA Pascoe, 1866

(?) SAIMIA HIRTICORNIS Gressitt sp. nov. Plate 1, fig. 13.

Moderately narrowed, subparallel; antennæ very hairy posteriorly. Body black, clothed with pubescence of mottled gray-brown, marked with brown, light gray, and ochraceous; head incompletely clothed with pale buff, mottled with darker in front and with a pair of longitudinal dark brown stripes on occiput, and another behind each upper eye lobe; antennæ with scape gray, the following segments pale gray basally and black apically, apical segments largely black, long internal hairs similarly colored, longer and denser posteriorly; prothorax gray-brown, spotted anteriorly with ochraceous and with four indistinct dark stripes on disc; elytra whitish gray, dotted with black punctures, crossed by two irregular brown fasciæ, one behind base, the other behind middle, and spotted irregular with ochraceous; undersurfaces densely clothed with gray and ochraceous, reddish on posterior margins of abdominal segments, also some flying gray hairs; legs brown and buff; tarsi with first, second, and last segments light gray basally, black apically, the third entirely black.

Head sparsely punctured; eyes small, the two lobes connected by a fine line; frons higher above than below. Antennæ one-fourth longer than body, apical segments and apical portions of basal segments clothed internally with long hairs; scape with an incomplete cicatrix; third segment longer than scape and fourth; following rapidly decreasing in length. Prothorax broader than long, tuberculate anteriorly at sides; disc with five swellings, a pair of elongate ones in the middle and three in a transverse row near base. Scutellum small and narrow. Elytra broad, rounded behind; surface sparsely and heavily punctured. Sternal processes with opposing faces vertical. Length, 13 to 14 millimeters; breadth, 4.5 to 5.

Holotype, female (?), No. 51429, United States National Museum; Hassenzan, Formosa, altitude 1,300 meters, June 21, 1932; two paratopotypes in the author's collection, and a paratopotype in the California Academy of Sciences (Van Dyke collection), June 22 to 26, 1934.

This species differs from *S. alternans* Schwarzer with its hairy antennæ, the scape and apical segments shorter, its tuberculate prothoracic disc, and its vertical sternal processes.

HIPPOPSINI

Genus PSEUDOCALAMOBIUS Kraatz, 1879

PSEUDOCALAMOBIUS LEPTISSIMUS Gressitt sp. nov. Plate 1, fig. 14.

Extremely narrow and elongate, antennæ very fine and long, head fully as deep as rest of body; brown, anterior femora and scape dull reddish brown, rest of antennæ dark brown; head and thorax blackish brown, reddish brown on posterior margin of pronotum, clypeus dark amber, labrum light reddish brown, mandibles and palpi dark reddish brown, elytra dull chocolate-brown, redder at sides, legs and abdomen very dark chocolate-brown; antennæ with basal five segments clothed below with fine erect hairs, rest of body very finely clothed with minute, pale grayish brown hairs, sparser on elytra and denser on midline of pronotum, scutellum, and basal portion of elytral suture.

Head squarish in front, excluding mouth parts, broadest at eyes, slightly broader across genæ than at antennal tubercles; vertex fairly deeply concave between antennal tubercles, which are prominent, and swollen internally; frons weakly convex, apical margin slightly concave; clypeus short, impunctate; labrum convex, punctulate; palpi with apical segments of each pair swollen basally and acutely attenuate apically. Antennæ two and one-half times as long as body, exceedingly fine; scape cylindrical, reaching well beyond middle of prothorax; second segment barely longer than broad; third segment longer than first and shorter than fourth; fourth to tenth subequal; eleventh nearly double third. Prothorax roughly cylindrical, one-third longer than broad, widest before and behind middle. Scutellum longer than broad, rounded behind. Elytra long and narrow, slightly narrowed posteriorly; apices narrowed externally and produced into a blunt point at suture. Abdomen with first segment nearly twice as long as fourth, others subequal. Legs with femora swollen, hind pair no longer than first abdominal segment. Body largely finely punctured, elytra subseriately, abdomen most finely, and antennæ and lateral portions of meta-

sternum most heavily. Length, 10.5 to 12 millimeters; breadth, 1.5 to 2.

Holotype, female, No. 51428, United States National Museum; Arisan, central Formosa, altitude 2,300 meters, May 23, 1934, three paratopotypes, females, May 23 to 25, and a paratype, male, Taiheizan, northeastern Formosa, altitude 1,800 meters, May 8, 1932, in the author's collection; all collected by the author.

This species differs from *P. filiformis* Fairm. in being smaller and less parallel, in having the antennæ finer and less hairy below, and the elytra acute apically and lacking longitudinal stripes.

Genus METOPOPLECTUS Gressitt novum

Frons trapeziform; head directed posteriorly below; antennæ very long, scape swollen apically; prothorax nontuberculate; anterior coxal cavities closed behind; middle coxal cavities open exteriorly; tarsal claws moderately divergent; form only moderately elongate, narrow in fore body; shoulders prominent; elytra slightly narrowed posteriorly.

Head as broad as prothorax, subacute at apex, nearly twice as broad at genæ as at antennal tubercles, which latter are prominent and close; frons higher than wide, subparallel; eyes small, almost entire, hardly extending behind antennal supports, not very finely faceted; genæ large; clypeus short; labrum with apical margin slightly concave; palpi with last segment of each pair narrowed and subacute apically. Antennæ two and two-thirds to three and one-half times as long as body; scape reaching nearly to posterior margin of prothorax, gradually swollen posteriorly, second segment about as long as broad; third to tenth subequal and nearly as long as first; last longer than two preceding combined. Prothorax cylindrical, one-fourth longer than broad; base hardly broader than apex, two-thirds as broad as elytra. Scutellum as long as broad, rounded behind. Elytra very slightly narrowed in basal three-fourths; apices fairly abruptly narrowed, and narrowly rounded, or subtruncate, at suture. Abdomen with first segment not quite as long as following two united. Legs short; femora moderately swollen; hind pair reaching to middle of abdomen; middle tibiæ obliquely grooved exteriorly; tarsi nearly as long as tibiæ, the hind pair with the first segment barely as long as the following two united, last longest.

Genotype.—*Metopoplectus taiwanensis* Gressitt sp. nov.

Range.—Formosa and eastern China.

This genus is established for the following new species, as well as for *Cleptometopus orientalis* Mitono and an undescribed species from China.

Differs from *Cleptometopus* Thomson in being broader, in having the head shorter and less acute, the frons broader, the scape more swollen apically, the succeeding antennal segments lacking long apical hairs, the prothorax being less elongate and less narrowed apically, the elytra less attenuated, less heavily punctured basally, and not spined posteriorly, their surface with concave areas; and from *Pothyne* in having the superior lobes of eyes lacking, the antennæ much less hairy, the scape swollen, the prothorax narrower, and the elytra shorter. The form is less linear than in most Hippopsini, the elytra being considerably broader than the head and prothorax.

METOPOPLECTUS TAIWANENSIS Gressitt sp. nov. Plate 1, fig. 15.

Largely dull chocolate-brown, elytra partly very light brown, body clothed below with short grayish brown hairs and above with dark chocolate, and light tawny brown, hairs; front of head slightly reddish brown with a few pale hairs, thicker at sides; occiput blackish brown with a narrow midlongitudinal stripe of tawny hairs, and similar clothing behind eyes; antennæ with scape reddish brown on basal two-thirds, the apex blackish, remaining segments light brown basally, and dark chocolate-brown apically; prothorax with a median, and two lateral, broad, longitudinal tawny stripes; scutellum tawny; elytra dark brown basally, a few oblique pale stripes extending from basal portion of disc, humerus, and lateral margin, converging and meeting suture before middle, then an oblique dark brown area, irregular posteriorly and broader at suture, along which it extends posteriorly, joining inner one of two longitudinal subapical dark stripes, inner one not adjacent to suture, extreme apex dark, intervening postmedian and subapical areas pale brown.

Head fairly densely and finely punctured, not quite as broad near apices of genæ as at eyes, much narrower across antennal tubercles; eyes small, entire, very slightly longer than broad, rounded below and bluntly angulate above. Antennæ three to three and one-half times as long as body; scape swollen apically, very slightly longer than third segment; third to tenth subequal, last very long; five basal segments sparsely clothed below with short fine hairs. Prothorax barely longer than broad, very slightly swollen in middle; basal two-thirds as broad as elytra; surface fairly densely, and finely, punctured. Elytra very slightly narrowed in basal three-fourths; apices narrowly rounded at

suture; surface fairly densely, and moderately heavily, punctured in twelve or more rows, less heavily so posteriorly. Ventral surface moderately punctured, more heavily on sides of metasternum and more finely on abdomen. Length, 9.5 to 10.3 millimeters; breadth, 2.2 to 2.5.

Holotype, female, No. 51430, United States National Museum; Sakahen, northeastern Formosa, altitude 1,100 meters, July 16, 1934; allotype, male, Hori, central Formosa, at about 600 meters, June 9, 1934, in the author's collection; both taken by the author.

Differs from *M. orientalis* (Mitono) in its smaller size, its more swollen, and more arched, antennal scape, its less cylindrical prothorax, its rounded, instead of subacute, elytral apices, and its strongly punctured metasternum. The elytra are also less densely punctured than in the latter.

Genus ARISANIA Gressitt novum

Elongate, parallel-sided, cylindrical; frons narrow, broadest at antennal tubercles, which are very prominent; antennæ twice as long as body; pronotum with a small tubercle at each side; anterior coxæ subglobular, separate, closed behind; middle coxal cavities open exteriorly; middle tibiæ grooved externally; legs short, hind femora nearly as long as first two abdominal segments, tarsal claws divaricate; elytra long, rounded-truncate apically.

Head as broad as prothorax, higher than wide, directed slightly posteriorly below; eyes moderately narrow and long, very narrowly constricted behind antennal supports, ventral lobe large, fairly closely approaching mandibles, dorsal lobe minute; antennal tubercles large and very prominent, contiguous basally, diverging at an angle of 100°; frons higher than wide, broadest at antennal supports, subparallel below, swollen; clypeus short; labrum longer than clypeus, more than half as long as broad, punctulate; mandibles short, very thick basally; genæ minute; palpi with the apical segment of each pair subfusiform, thickened basally and truncate apically. Antennæ two and one-half times as long as body in male, twice as long in female; scape reaching to about middle of prothorax, subcylindrical, narrow at base, thickest before apex, external apical margin slightly emarginate; second segment broader than long; third to seventh segments subequal, cylindrical, progressively slightly longer and finer; last four segments shorter and finer; last longer than tenth, shorter than third. Prothorax as long as broad, broader at apex than at base; slightly constricted before the base, furnished with a

short, conical tubercle at each side, slightly behind middle; a slight swelling behind middle of disc; middle of posterior margin raised. Scutellum nearly as long as broad, rounded truncate behind. Elytra long, parallel, slightly constricted before middle, very slightly narrowed and subobliquely truncated at apices; surface subseriate-punctate. Anterior coxæ prominent, subglobose, their cavities angulate externally, separate, closed behind; middle coxæ less prominent, their cavities open externally to epimera; metasternum swollen at sides and abruptly declivitous apically; metepisternum narrowed posteriorly. Abdomen with last segment as long as first; second, third, and fourth successively shorter; last segment slightly emarginate below at apex in male, concave in apical half in female. Legs short, femora moderately swollen; tarsi as long as tibiæ, first segment of hind pair not as long as following two segments combined, claws divaricate.

Genotype.—*Arisania submarmorata* Gressitt sp. nov.

Range.—Formosa (central).

This genus is doubtfully placed in the Hippopsini, differing from the characteristic genera in having the frons narrowed apically, the antennæ not ciliate below, except for scape, the prothorax with a small tubercle at each side, and the tarsal claws divaricate. Differs in form from *Pseudocalamobius* in being broader and more cylindrical, with the antennæ thicker, and shorter in the male.

ARISANIA SUBMARMORATA Gressitt sp. nov. Plate 1, fig. 16.

Elongate, parallel; elytra two and one-half times as long as head and prothorax united; frons narrowed apically; antennal tubercles prominent; prothorax slightly tuberculate laterally; hind femora hardly reaching to end of second abdominal segment.

Reddish brown, blackish on front of head, middle of prothorax and ventral surface of body; body largely covered with short, recumbent brown hairs, forming mottled patterns: antennæ poorly clothed, scape only with very short, fine, erect hairs below; head, prothorax, and scutellum with light rusty brown hairs, an irregular naked patch in middle of disc of latter; elytra with a small, irregular, subbasal, discal spot and the apical third largely light rusty brown, a short, transverse, hairless band preceding the latter area, anterior three-fifths thinly and irregularly clothed with small spots of grayish brown hair; ventral surface grayish brown, sides of metathorax, apical segments, and sides

of basal segments, of abdomen irregularly rusty. Length, 7.5 to 10.5 millimeters; breadth, 1.5 to 2.5.

Holotype, male, No. 51431, United States National Museum; Arisan, Formosa, altitude 2,250 meters, June 4, 1932, allotopotype female, and 3 male paratopotypes in the author's collection, all taken the same day by the author.

The middle portion of each antennal segment is pale in the female.

Genus OBEREA Mulsant, 1839

OBEREA BREVITHORAX Gressitt sp. nov. Plate 1, fig. 17.

Elongate, prothorax short, elytra long, narrowed after basal third and slightly expanded preapically; head and antennæ pitch black, except for amber-colored clypeus and pale orange palpi; prothorax pale orange below, duller orange above with a very small black spot at each side near base; scutellum brownish black; elytra grayish black along suture and shiny black on shoulders, sides, and apices, yellow on middle of basal margin and with a walnut brown stripe along middle of disc to near apex, dotted with black punctures, subhumeral areas orange; ventral surface orange, except for black metepisternum, posterior three-fourths of metasternum, lateral margin of first, sides of second and third, and all but base of fifth, abdominal segments, hind tibiæ, external margins of anterior and middle tibiæ and tarsi above, except for base of third segment and large part of last, which is brown. Forebody and underside clothed with short, reclining hairs and longer and sparser erect pale or golden hairs, those on last abdominal segment and the erect ones on head black, elytra with pale reclining hairs on inner black portion and some erect ones on basal portion, the brown stripe nearly naked, shiny.

Head strongly swollen in front, very slightly concave on vertex, fairly heavily punctured except on posterior portion of occiput; eyes large, deeply constricted, ventral lobe broader than long, closely approaching mandibles. Antennæ (female) reaching to last fifth of elytra, all segments except second subequal in length. Prothorax very short, two-thirds as long as broad, hardly as broad as elytra at base, swollen above and with a raised area at each side; surface irregularly punctured, more sparsely on center of disc. Scutellum short, its posterior margin transverse. Elytra fully four times as long as head and prothorax united, narrowed and subparallel after first quarter, slightly expanded in last fifth; apices obliquely emarginate internally, with a small tooth at suture and a larger one at exter-

nal angle; surface with six longitudinal rows of large punctures. Mesepisternum moderately punctured, narrowed and raised above; metepisternum heavily punctured; metasternum punctured moderately at sides, more finely anteriorly; abdominal segments slightly punctured at sides. Legs short, hind femora reaching but slightly beyond end of first abdominal segment. Length, 19 millimeters; breadth, 2.5.

Holotype, female, California Academy of Sciences; Hori, Formosa, altitude 500 meters, June 9, 1934; collected by the author.

This species differs from *O. binotaticollis* Pic in having the prothorax short, the elytra much more attenuate, more oblique at the apices, more heavily punctured, relatively naked and partly brown, and the last abdominal segment shiny black except at base; it differs from *O. holoxantha formosana* Pic in having the head broader, the prothorax much shorter, and the elytra more attenuate, besides being largely black and brown.

JAPANESE NAMES

1. *Aromia faldermanni insularis* subsp. nov. Kikubi-usubane-kamikiri.
2. *Chloridolum loochooanum taiwanum* subsp. nov. Taiwan-midori-kamikiri.
3. *Kurarua constrictipennis* gen. et sp. nov. Kuraru-hosobane-kamikiri.
4. *Merionœda uraiensis* Kano. Urai-momobuto-hana-kamikiri.
5. *Merionœda formosana* Heller. Momobuto-hana-kamikiri.
6. *Xylotrechus rufonotatus* sp. nov. Akamon-tora-kamikiri.
7. *Perissus griseus* sp. nov. Usuao-tora-kamikiri.
8. *Raphuma notabiloides* sp. nov. Sakahen-tora-kamikiri.
9. *Demonax matsushitai* sp. nov. Matsushita-tora-kamikiri.
10. *Chlorophorus demonacoides* sp. nov. Suisha-tora-kamikiri.
11. *Chlorophorus miwai* sp. nov. Miwa-tora-kamikiri.
12. *Bunothorax* gen. nov. *takasagoensis* (Kano). Takasago-beni-kamikiri.
13. (?) *Saimia hirticornis* sp. nov. Kehige-gomafu-kamikiri.
14. *Pseudocalamobius leptissimus* sp. nov. Kōzan-dōboso-kamikiri.
15. *Metopoplectus taiwanensis* gen. et sp. nov. Hime-ebicha-higenaga-kamikiri.
16. *Arisania submarmorata* gen. et sp. nov. Arisan-higenaga-kamikiri.
17. *Oberea brevithorax* sp. nov. Tankubi-ringo-kamikiri.

ERRATUM

In the preceding paper of this series, Philip. Journ. Sci. 58 (1935) 253–266, on pages 259, 260, and 266, the genus should read *Anoploderomorpha*, instead of *Anoplodermorpha*.

ILLUSTRATION

PLATE 1

[Magnified 1¾ times.]

FIG. 1. *Aromia faldermanni* subsp. *insularis* Gressitt nov., holotype.
2. *Chloridolum loochooanum* subsp. *taiwanum* Gressitt nov., holotype.
3. *Bunothorax* (gen. nov.) *takasagoensis* (Kano), Taiheizan, Formosa.
4. *Raphuma notabiloides* Gressitt sp. nov., holotype.
5. *Kurarua constrictipennis* Gressitt gen. et sp. nov., holotype.
6. *Merionœda uraiensis* Kano, Bukai, Formosa.
7. *Merionœda formosana* Heller, Hassenzan, Formosa.
8. *Perissus griseus* Gressitt sp. nov., holotype.
9. *Xylotrechus rufonotatus* Gressitt sp. nov., holotype.
10. *Demonax matsushitai* Gressitt sp. nov., holotype.
11. *Chlorophorus demonacoides* Gressitt sp. nov., holotype.
12. *Chlorophorus miwai* Gressitt sp. nov., paratype, Hori, Formosa.
13. (?) *Saimia hirticornis* Gressitt sp. nov., holotype.
14. *Pseudocalamobius leptissimus* Gressitt sp. nov., holotype.
15. *Metopoplectus taiwanensis* Gressitt gen. et sp. nov., holotype.
16. *Arisania submarmorata* Gressitt gen. et sp. nov., holotype.
17. *Oberea brevithorax* Gressitt sp. nov., holotype.

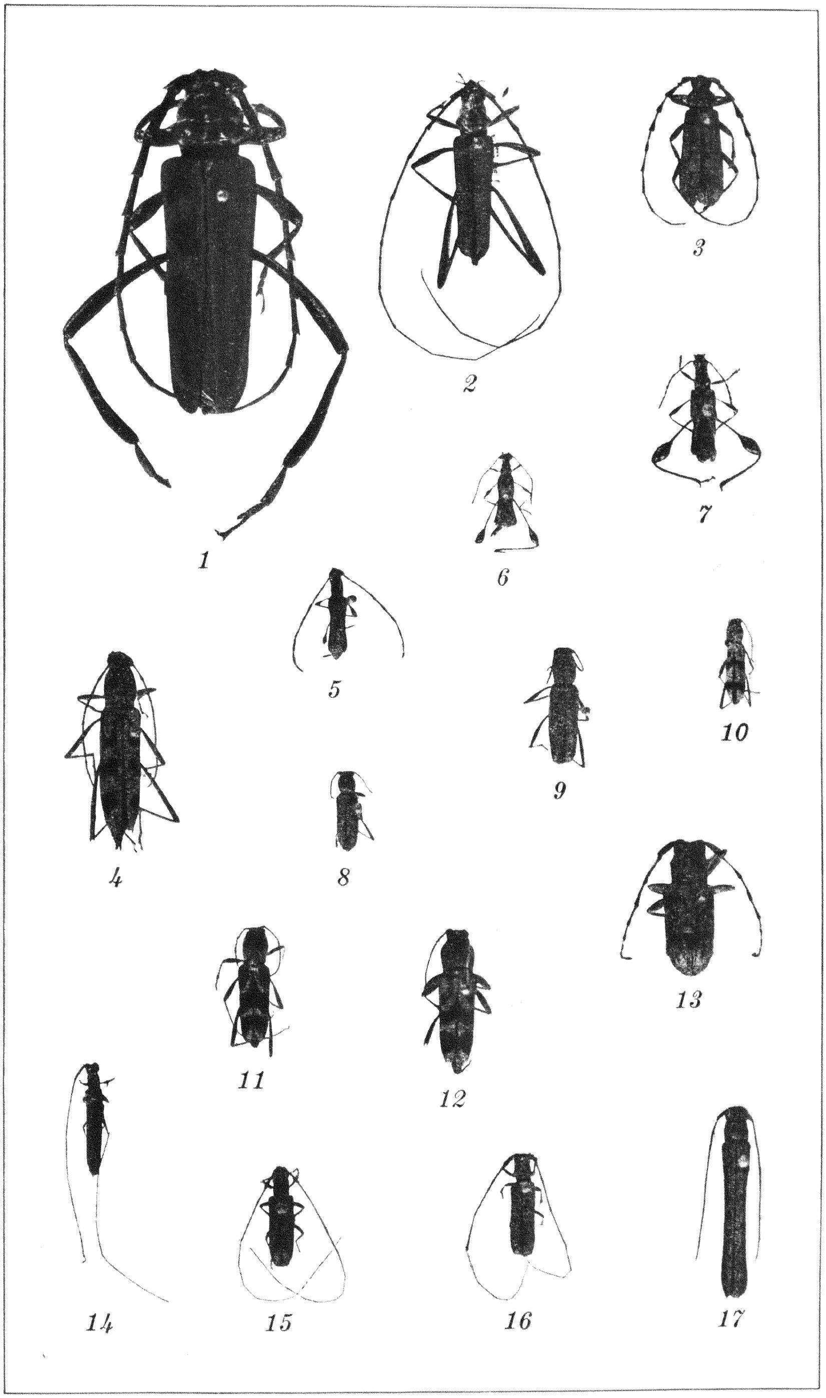


PLATE 1.

NEW OR LITTLE-KNOWN TIPULIDÆ FROM EASTERN ASIA (DIPTERA), XXXII[1]

By CHARLES P. ALEXANDER

Of Amherst, Massachusetts

TWO PLATES

Virtually all of the species of crane flies herein discussed are from Hainan Island where they were collected in 1935 by Mr. J. Linsley Gressitt. A few additional species are from the Khasi Hills, Assam, secured by Mr. S. Sircar and associated entomologists. All the types of novelties described at this time are preserved in my very extensive collection of these flies. I wish to express my very deepest thanks to the above-mentioned entomologists for their friendly coöperation in continuing this study of the Tipulidæ of southeastern Asia.

The rather extensive collections made in Hainan proved to be of exceptional interest, since virtually nothing had been made known of this rich faunal area. I am indebted to Mr. Gressitt for the following notes concerning various collecting stations at which Tipulidæ were secured:

TA HIAN. Altitude 2,000 feet, by stream, near northwestern foot of the Five Finger Mountains, south of the middle of the island; 10 miles south of Fan Heang.

TA HAN. Altitude 2,500 feet; small valley between passes of the Loi Mother Ranges and the Red Mist (Hung Mo) Range; on way from Nodoa to the Five Finger Mountains, about 20 miles north of Ta Hian.

TA HAU. Altitude about 900 feet; a small village near Vo Lau, in Dam-Chui, west and slightly south of Nodoa about 30 miles; flat country.

NODOA (NOTAI). Altitude about 1,000 feet; flat country, in the northwest-central part of the island.

FAN TA. Altitude about 1,250 feet; 22 miles south of Nodoa; beginning of low mountains.

CHUNG KON. Altitude about 1,050 feet; between Nodoa and Loi Mother Mountain, near Deng-ag River.

[1] Contribution from the entomological laboratory, Massachusetts State College.

DWA BI (TAI PIN). Altitude about 1,500 feet, at foot of north end of Loi Mother Range; about 20 miles west and slightly north of Liamui, near the center of the island.

LIAMUI. Altitude about 1,200 feet, near the eastern edge of mountains on a low plateau, with mountains on its east, between it and the great northern plain. From the hills around can be seen the Loi Mother Mountain, Red Mist Mountain, and the Five Fingers, to the west and southwest.

Besides the score of species of Tipulidæ described as new in the present report, Mr. Gressitt secured a number of additional crane flies that are recorded herewith to complete the data.

LIMONIA (RHIPIDIA) PULCHRA (de Meijere).

Ta Hian, June 13, 1935.

LIMONIA (GERANOMYIA) ARGENTIFERA (de Meijere).

Ta Hian, June 14, 1935; Ta Han, June 7, 1935; Liamui, July 31, 1935.

LIMONIA (THRYPTICOMYIA) APICALIS (Wiedemann).

Ta Hian, June 11, 1935; Ta Han, June 22 and 23, 1935.

CONOSIA IRRORATA (Wiedemann).

Ta Hian, June 15 to 18, 1935; Ta Han, June 22 to 24, 1935; Ta Hau, July 3, 1935; Nodoa, June 30, 1935; Chung Kon, July 17, 1935.

TRENTEPOHLIA (MONGOMA) PENNIPES (Osten Sacken).

Chung Kon, July 18, 1935.

TRENTEPOHLIA (TRENTEPOHLIA) PICTIPENNIS Bezzi.

Ta Hian, June 11, 1935; Ta Han, June 21, 1935.

TRENTEPOHLIA (TRENTEPOHLIA) TRENTEPOHLII (Wiedemann).

Ta Hian, June 11, 1935; Nodoa, June 20, 1935; Liamui, July 2, 1935; Ta Hau, July 4, 1935; Chung Kon, July 18, 1935; Dwa Bi, July 21, 1935.

GONOMYIA (LIPOPHLEPS) BICOLORATA Alexander.

Ta Han, June 23, 1935. Known hitherto only from Luzon.

GONOMYIA (LIPOPHLEPS) INCOMPLETA Brunetti.

Ta Hian, June 14, 1935; Ta Hau, July 3, 1935; Chung Kon, July 18, 1935; Dwa Bi, July 20, 1935.

TIPULINÆ

LONGURIO HAINANENSIS sp. nov. Plate 1, fig. 1.

General coloration of mesonotum and abdomen yellow and orange; head variegated with brownish black on lateral por-

tions of posterior vertex; wings narrow, tinged with gray; Rs short and arcuated, much shorter than R_{2+3}; m-cu a short distance before fork of M_{3+4}.

Female.—Length, about 20 millimeters; wing, 15.

Frontal prolongation of head yellowish white; nasus conspicuous, black; palpi black. Antennæ dark brown throughout, very small, if bent backward scarcely extending beyond the posterior border of head; flagellar segments cylindrical, with long, conspicuous verticils. Head whitish on front and anterior vertex, the central portion of posterior vertex and occiput yellow, the lateral portions of latter, together with the posterior orbits, brownish black.

Pronotum and propleura black. Mesonotum almost uniformly yellow, restrictedly variegated by darker, including the lateral ends of suture, margins of parascutella, and posterior border of mediotergite. Pleura obscure yellow, the posterior border of dorsopleural membrane with a conspicuous velvety black area; posterior portion of pleurotergal tubercle a little darkened. Halteres dirty white, the knobs darkened. Legs with the coxæ yellowish testaceous; trochanters whitened; remainder of legs brownish black. Wings (Plate 1, fig. 1) narrow, subhyaline or with a faint grayish tinge; stigma and cell Sc a little darker; veins brown. Macrotrichia on outer portions of veins R_3 and R_{4+5}; trichia on outer medial branches lacking or reduced to one or two scattered setæ. Venation: Rs short and arcuated, much shorter than R_{2+3}; distal end of Sc_1 atrophied; m-cu a short distance before fork of M_{3+4}; cell 2d A relatively wide.

Abdominal tergites orange-yellow, the incisures restrictedly paler; intermediate tergites with vague medial darkenings, on outer segments more evident and suffusing the caudal borders of the segments; sternites more yellowish, with a more or less distinct brown median stripe; pleural membrane infuscated. Ovipositor with small and inconspicuous, blunt valves.

Habitat.—China (Hainan Island).

Holotype, female, Dwa Bi, altitude about 1,500 feet, July 20, 1935 (*Gressitt*).

Longurio hainanensis is readily told from the four species hitherto described from China and Japan by the narrow, subhyaline wings, with Rs unusually short and arcuated. The most similar of the above-mentioned forms is *L. fulvus* Edwards (China, Formosa). I am not fully convinced that *Sphærionotus* de Meijere can be maintained as a genus distinct from *Longurio* Loew.

NEPHROTOMA HAINANICA sp. nov. Plate 1, fig. 2.

General coloration yellow, patterned with black; frontal prolongation of head darkened on sides; head orange, with no occipital brand; mesonotal præscutum with three polished black stripes that are narrowly bordered by velvety black, the central portion of median stripe paler on anterior half; scutellum, postnotum, and pleura yellow; wings with a faint dusky tinge, the stigma and cells Sc and Cu_1 darker; Sc_2 ending a short distance beyond origin of Rs, the latter subequal in length to R_{2+3}; cell M_1 broadly sessile; abdominal tergites weakly infuscated medially, the disk of the seventh tergite intensely blackened.

Female.—Length, about 14 millimeters; wing, 11.

Frontal prolongation of head light yellow above, dark brown on sides; nasus black, conspicuous. Antennæ with the scape brown; pedicel dark brown; flagellum black. Head orange; vertical tubercle very weakly notched; no differentiated occipital brand.

Pronotum and pleura orange-yellow. Mesonotal præscutum yellow with three polished black stripes, all narrowly bordered by velvety black; anterior end of median stripe with its central portion yellow, this pale color continued caudad for nearly one-half the length of the stripe; lateral stripes straight; scutum yellow, each lobe with two confluent polished black areas that are very narrowly bordered by velvety black; lateral ends of transverse suture infumed; scutellum and mediotergite yellow, without darkening, the latter with delicate setulæ on posterior lateral portions. Pleura yellow, variegated by more reddish yellow areas on the propleura, anepisternum, ventral sternopleurite, and meron. Halteres dusky, the base of stem restrictedly pale. Legs with the coxæ and trochanters yellow, the fore coxæ more reddish yellow; femora brownish yellow, somewhat clearer yellow at base, a little more darkened outwardly; tibiæ and tarsi brownish black to black. Wings (Plate 1, fig. 2) with a faint dusky tinge; stigma cell Sc, and the narrow cell Cu_1 infuscated; wing tip very gradually and insensibly darker than the remaining ground color of the membrane; veins dark brown. Stigmal trichia few. Venation: Sc_1 entirely preserved, Sc_2 ending a short distance beyond the origin of Rs, the latter subequal in length to R_{2+3} cell M_1 broadly sessile; m-cu at point of departure of vein M_4.

Abdominal tergites weakly infuscated medially, somewhat paler sublaterally at bases of segments; disk of seventh tergite intensely blackened, the borders yellow, the lateral margins more broadly

so; sternites more uniformly yellow. Ovipositor with genital shield obscure yellow; cerci nearly straight.

Habitat.—China (Hainan Island).

Holotype, female, Ta Han, altitude 2,500 feet, June 22, 1935 (*Gressitt*).

The thoracic pattern, especially the highly polished præscutal stripes that are narrowly margined with velvety black, is much as in *Nephrotoma siamensis* Edwards, which differs conspicuously in the occipital brand, black central præscutal vitta, dull black scutellum and apical third of mediotergite, and numerous other features. The coloration of the median præscutal stripe is approached by the otherwise very different Formosan species, *N. parva* Edwards.

CYLINDROTOMINÆ

PHALACROCERA TARSALBA sp. nov. Plate 1, fig. 3.

Front and anterior vertex silvery white, posterior vertex black; prothorax light yellow; mesonotum almost uniformly black; pleura yellow; legs darkened, the tarsi chiefly snowy white; wings narrow, the prearcular region petiolate; m-cu at fork of M; cell 2d A reduced to a narrow strip; abdominal tergites black, the sternites more greenish brown; ovipositor and genital segment brownish yellow.

Female.—Length, about 8 millimeters; wing, 8.

Rostrum yellow, palpi dark brown. Antennæ relatively short; scape and pedicel yellow, flagellum brownish black; flagellar segments passing into cylindrical, with verticils that much exceed the segments; terminal segment about one-half longer than the penultimate. Front and anterior vertex broad, silvery white; posterior vertex black, the occiput paling to dull yellow.

Prothorax entirely light yellow. Mesonotum almost uniformly black, greatly restricting the obscure yellow ground colors; præscutum with three confluent stripes, the yellow ground reduced to narrow humeral triangles; median regions of scutum and scutellum restrictedly pale; mediotergite narrowly margined with yellow, the disk black. Pleura and pleurotergite, together with the pleural membranes, uniformly pale yellow. Halteres dusky, the knobs infuscated, the base of stem restrictedly yellow. Legs with the coxæ and trochanters yellow; femora greenish basally, the tips gradually passing into brown; tibiæ brown, the tips darker; tarsi snowy white, the proximal ends of basitarsi blackened. (All legs are detached and the degree of blackening differs in the various legs; in some, only

the extreme tip, the distal fifth or sixth, is whitened, while in one pair, which is presumably the posterior one, the white includes the distal three-fifths.) Wings (Plate 1, fig. 3) with a weak brown tinge; stigma small, long-oval, dark brown; veins dark brown, the prearcular veins more yellowish brown. Wings with a long basal petiole. Venation: Sc_1 atrophied; Sc_2 ending just beyond fork of Rs, the free tip evident as a faint trace at near midlength of the stigma, m-cu at fork of M; cell 2d A reduced to a narrow strip.

Abdominal tergites black; sternites more greenish brown; ovipositor and genital segment brownish yellow.

Habitat.—China (Hainan Island).

Holotype, female, Ta Han, altitude 2,500 feet, June 25, 1935 (*Gressitt*). Paratopotypes, 1 female, 1 (sex?), June 21 and 22, 1935.

Phalacrocera tarsalba is readily told from all other allies in eastern Asia by the unusually narrow, petiolate wings, very narrow cell 2d A, and the snowy white tarsi. It has no close relative so far made known, the most similar form being *P. minuticornis* Alexander (western China). The discovery of a Palæarctic element such as the genus *Phalacrocera* at relatively low altitudes in Hainan has provided a surprise in geographic distribution.

LIMONIINÆ

LIMONIINI

Genus LIMONIA Meigen

Limonia MEIGEN, Illiger's Magazin 2 (1803) 262.

Subgenus GRESSITTOMYIA novum

Characters as in typical *Limonia,* differing most evidently in details of wing venation.

Antennæ 15-segmented; flagellar segments oval, the longest verticils unilaterally distributed on outer face, about one-third longer than the segments; terminal segment slender, about two-thirds the length of the penultimate. Anterior vertex narrower than the diameter of the scape. Claws with a single short spine near base. Wings (Plate 1, fig. 4) with Sc moderately long, Sc_1 ending beyond two-thirds the length of Rs, Sc_2 close to its tip; $Sc_2 + R_1$ gradually bent strongly caudad, at its outer end reducing vein R_2 to a short hyaline element, the free tip of Sc_2 correspondingly lengthened but entirely pale; a supernumerary crossvein in cell R_3 at near midlength; vein R_3 beyond the cross-

vein strongly sinuous, slightly constricting cell R_3 at near midlength; a long fusion of veins R_{4+5} and M_{1+2}, nearly equal in length to Rs, completely obliterating r-m; cell 1st M_2 narrowed to a point at outer end, m being very short to nearly obliterated; outer medial veins deflected strongly caudad; m-cu at or close to fork of M, cell M_4 at margin unusually wide; anal veins nearly straight, parallel at origin. Male hypopygium (Plate 2, fig. 25) with the dorsal dististyle, *dd*, well developed, slender. Ventral dististyle, *vd*, small, with a long, slender, rostral prolongation that bears two, long, slender spines on a small tubercle at base; face of style bearing a larger and more conspicuous tubercle that has three, very long, slender setæ, these exceeding in length the rostral prolongation of the style.

Type of subgenus.—*Limonia* (*Gressittomyia*) *xenoptera* sp. nov. (Oriental Region: Eastern China, Hainan Island.)

The crane fly discussed under the above name is one of the strangest in appearance that has ever come to my attention. At first sight the venation seems quite irreconcilable with that of members of the genus *Limonia*, the veins beyond the cord being unusually complicated by fusions of elements and the presence of a supernumerary crossvein in cell R_3. However, there is no doubt that the fly is a member of the great genus *Limonia* and that it is necessary to erect a new subgeneric group for its reception. I take great pleasure in dedicating this subgenus to Mr. J. Linsley Gressitt, who has added materially to our knowledge of the Tipulidæ of eastern Asia.

The most unusual character of the group and the one that separates it from all other subgenera of *Limonia* is the profound fusion of veins R_{4+5} and M_{1+2}, a character suggested by certain other species of the genus, as *Limonia* (*Laosa*) *gloriosa* (Edwards) where the contact of veins R_{4+5} and M_{1+2} is merely punctiform. Elsewhere in the Tipulidæ such a long fusion of veins R_{4+5} and M_{1+2} is rare, being most evident in the tipuline genus *Ptilogyna* Westwood and in the limoniine genus *Trentepohlia* Bigot. In other groups of the Limoniinæ, a fusion of this nature occurs sporadically in genera such as *Helius* St. Fargeau and *Teucholabis* Osten Sacken, but throughout the entire family Tipulidæ its occurrence must be held to be decidedly uncommon. The presence of a supernumerary crossvein in the outer radial field is a character likewise possessed by three other subgenera of *Limonia;* namely, *Laosa* Edwards, *Dapanoptera* Westwood, and *Neolimnobia* Alexander. The group most nearly allied to

Gressittomyia would seem to be *Laosa*. For additional details and comparisons the discussion of the subgenera of *Limonia* as given by the writer in an earlier paper [2] may be consulted.

LIMONIA (GRESSITTOMYIA) XENOPTERA sp. nov. Plate 1, fig. 4; Plate 2, fig. 25.

General coloration orange; antennæ with scape and pedicel black, the flagellum obscure yellow, its outer segments more darkened; head silvery gray, with a capillary dark line on posterior vertex; halteres yellow, the knobs darkened; legs yellow, the femoral tips rather broadly blackened; wings hyaline, the prearcular and costal fields more yellowish, the outer radial, cubital, and anal fields more buffy; veins beyond cord conspicuously seamed with brownish black; R_{4+5} extensively fused with M_{1+2}; m very short to virtually lacking; male hypopygium with the rostral spines slender, from a common tubercle at base of prolongation.

Male.—Length, about 7 millimeters; wing, 8.2.

Rostrum and palpi black. Antennæ with scape and pedicel black; flagellum obscure yellow, the outer segments passing into brownish yellow; antennal structure as described under subgenus. Head silvery gray, with narrow black median line on posterior vertex.

Entire thorax orange, immaculate. Halteres yellow, the knobs dark brown. Legs yellow, the femoral tips rather broadly black, the amount subequal on all legs; outer tarsal segments infumed. Wings (Plate 1, fig. 4) hyaline, the prearcular region and cells C, Sc, and R light yellow; outer portion of cell R, cell 1st M_2, and base of R_5, with outer ends of cells Cu, 1st A, and 2d A, together with basal portion of Cu more buffy; veins beyond cord narrowly but conspicuously seamed with brownish black; veins black in the outer fields, paler in the cells basad of cord. Venation as described under the subgenus; second section of vein R_{4+5} subequal in length to the second section of M_{1+2}; Vein Cu_2 lying unusually far distant from vein Cu_1.

Abdomen, including hypopygium, deep orange, the pleural membrane weakly infumed; ventral dististyle of hypopygium infuscated. Male hypopygium (Plate 2, fig. 25) with the caudal margin of tergite, *9t*, transverse or very gently emarginate, the setæ at and near border. Basistyle, *b*, with ventromesal lobe large. Dorsal dististyle, *dd*, a slender blackened hook, the acute tip slightly decurved. Ventral dististyle, *vd*, with the body small, shorter than the dorsal dististyle, its rostral prolongation long

[2] Philip. Journ. Sci. 40 (1929) 239–248.

and slender. Mesal-apical lobe of gonapophyses very slender. Ædeagus broad at base, narrowed to the bilobed apex.

Habitat.—China (Hainan Island).

Holotype, male, Ta Han, altitude 2,500 feet, June 22, 1935 (*Gressitt*).

The species requires no comparison with any other known member of the genus.

LIMONIA (LIMONIA) CALCARIFERA sp. nov. Plate 1, fig. 5.

General coloration obscure yellow, the præscutum darkened medially; flagellar segments gradually lengthened to the outermost; eyes broadly contiguous, ommatidia relatively coarse; pleura obscure yellow, variegated by darkened areas; femora yellow, the tips black; wings cream-colored, the base and costal portion clearer yellow; a restricted dark pattern, including the small stigma and a cloud at origin of Rs; Sc relatively long; Rs angulated and short-spurred at origin; m-cu at fork of M; anal veins convergent basally; abdominal tergites light brown; apices of cerci simple.

Female.—Length, about 7 millimeters; wing, 6.8.

Rostrum brown, palpi a little darker. Antennæ dark brown throughout; basal flagellar segments short-oval, the outer ones passing through oval to subcylindrical, becoming progressively longer outwardly; terminal segment pointed on distal end, about a fifth longer than the penultimate; extreme apex of flagellar segments glabrous and forming a pedicel, but not suddenly narrowed into a neck; verticils of outer segments subequal to or a trifle longer than the segments. Eyes broadly contiguous on anterior vertex; ommatidia relatively large and coarse; posterior vertex brownish gray.

Pronotum brown. Mesonotal præscutum obscure yellow, more infuscated medially; lateral stripes little or scarsely evident; setæ of interspaces erect and unusually long; præscutum with a weak, median impressed line, best developed on posterior half; scutal lobes dark brown, median area broadly obscure yellow; scutellum obscure yellow on basal portion, the posterior margin broadly infuscated, weakly pruinose; mediotergite dark brown, paler on lateral portions. Pleura obscure yellow, the propleura, anepisternum, and dorsal sternopleurite slightly infuscated. Halteres pale basally, the outer end of stem and the knobs infumed. Legs with the coxæ and trochanters testaceous-yellow; femora yellow, the tips rather broadly and conspicuously blackened; tibiæ yellowish brown, the tips narrowly and gradually darkened; tarsi passing into brownish black. Wings (Plate 1,

fig. 5) with the ground color somewhat creamy, the prearcular region and cells C and Sc clearer yellow; stigma subcircular, brown; a very restricted, scarcely evident, dark pattern, appearing as small clouds at origin of Rs and fork of Sc, and as a very narrow and vague apical darkening; cord and outer end of cell 1st M_2 very slightly darkened, most evident as a deepening in the intensity of the veins; veins yellow, darker beyond cord and in the clouded areas. Venation: Sc relatively long, Sc_1 ending about opposite four-fifths the length of Rs, Sc_2 near its tip; Rs weakly angulated and spurred near origin; free tip of Sc_2 and R_2 in transverse alignment; cell 1st M_2 widened outwardly, m about one-half the basal section of M_3; m-cu at fork of M; anal veins convergent basally, 2d A very gently sinuous.

Abdominal tergites light brown, scarcely variegated with darker; sternites more yellowish. Ovipositor with valves reddish horn-color, the bases of the hypovalvæ blackened; cerci upcurved and acute at tips.

Habitat.—China (Hainan Island).

Holotype, female, Dwa Bi, altitude about 1,500 feet, July 22, 1935 (*Gressitt*).

The general appearance of the present fly indicates that it is a member of the *pendleburyi* group. It differs from the typical form of this group, *Limonia* (*Limonia*) *pendleburyi* Edwards, of the Federated Malay States, and allied species, in the coloration of the body, legs, and wings and in the details of venation. The angulated and spurred Rs is a peculiar feature in the present group of flies.

LIMONIA (LIBNOTES) QUINQUE-COSTATA sp. nov. Plate 1, fig. 6.

General coloration brownish yellow, the præscutum with four darker brown stripes; antennæ black throughout; thoracic pleura brownish yellow, variegated by blackened areas; knobs of halteres dark brown; femora brownish black, the tips narrowly and abruptly yellow; tibiæ and tarsi black; wings cream-yellow, with a restricted dark pattern, including five small areas along costal border; free tip of Sc_2 and R_2 in approximate transverse alignment; anal veins strongly convergent; cerci bidentate at tips.

Female.—Length, about 10 millimeters; wing, 9.

Rostrum obscure brownish yellow; palpi black. Antennæ black throughout; basal flagellar segments globular, passing through short-oval to elongate; terminal segment about one-half longer than the penultimate; longest verticils exceeding

the segments. Front and anterior vertex buffy, the posterior portion of head more fulvous; anterior vertex reduced to a narrow strip that is only a little wider than the diameter of a single ommatidium.

Pronotum dark brown above, brownish yellow on sides. Mesonotal præscutum brownish yellow, the humeral region clear yellow; four darker brown præscutal stripes, the intermediate pair entirely confluent on anterior third of sclerite; a narrow blackish area borders internally the yellowish humeral portion of sclerite; scutal lobes dark brown, the median region more grayish; scutellum pale; mediotergite light gray, a trifle paler medially, more darkened on sides. Pleura brownish yellow, variegated by blackened areas on ventral propleura, dorsopleural membrane, ventral anepisternum, and dorsal sternopleurite. Halteres relatively long, the stem yellow, the knob dark brown. Legs slender; fore coxæ dark brown, the middle and hind coxæ yellow; femora obscure yellow basally, gradually deepening to brownish black, the tips narrowly but conspicuously yellow, the amount subequal on all legs; tibiæ and tarsi black. Wings (Plate 1, fig. 6) with the ground color cream-yellow, with a restricted brown pattern that is confined to the vicinity of the veins, including a series of five costal areas, distributed as follows: Arculus; cell Sc at near one-third the distance to Rs; origin of Rs; fork of Sc; and the small circular stigmal area on vein R_{1+2}, only slightly invading R_2; additional dark seams to many of the veins, including the cord, outer end of cell 1st M_2, more than the basal half of vein R_{2+3}, and outer end of vein 2d A; veins yellow, darkened in the clouded areas. Venation: Sc_1 ending beyond level of m-cu, Sc_2 at its tip; Rs very gently arcuated about four times the basal section of R_{4+5}; free tip of Sc_2 lying shortly proximad of R_2; cell 1st M_2 of moderate length; m and basal section of M_3 subequal; m-cu at near one-third the length of cell 1st M_2; outer radial and medial veins nearly straight or only gently curved; anal veins strongly convergent.

Abdominal tergites chiefly dark brown, the caudal portions of the segments a little more reddish brown; sternites brighter. Cerci stout, bidentate at tips.

Habitat.—China (Hainan Island).

Holotype, female, Ta Haan, altitude 2,500 feet, June 21, 1935 (*Gressitt*).

By Edward's key to the species of *Libnotes*,[3] the present fly runs to couplet 33, differing markedly from all species in the wing pattern and leg coloration. It runs more or less directly to *Limonia* (*Libnotes*) *longinervis* (Brunetti), an entirely different species.

ANTOCHA (ANTOCHA) FLAVIDULA sp. nov. Plate 1, fig. 7; Plate 2, fig. 26.

Size small (wing, male, 3.5 millimeters); head light gray; antennæ short, flagellum black; thorax and abdomen light yellow; halteres pale yellow; femora yellow, the tips narrowly and gradually infuscated; wings cream-colored, with a restricted, pale brown clouded pattern; m-cu more than one-fourth its length before the fork of M; male hypopygium with the outer dististyle suddenly narrowed at apex into an acute black spine.

Male.—Length, about 3.5 millimeters; wing, 3.5.

Rostrum obscure yellow; palpi a trifle darker. Antennæ short; scape and pedicel yellowish brown, flagellum black; flagellar segments small, subglobular to short-oval, the outer ones becoming more elongate. Head light gray.

Entire thorax light yellow. Halteres pale yellow. Legs with the coxæ and trochanters yellow; femora yellow, the tips narrowly and gradually infuscated; tibiæ pale brown, the tips slightly darker; tarsi infuscated. Wings (Plate 1, fig. 7) cream-colored, with a vague but evident pale brown pattern, distributed as clouds at origin of Rs, stigma, along cord and outer end of cell 1st M_2, and at the outer ends of veins R_3 and 1st A; veins yellow, pale brown in the clouded areas. Veins behind R_1 entirely glabrous. Venation: Sc relatively long, Sc_1 ending some distance beyond the fork of Rs; R_2 in virtual transverse alignment with r-m; cell 1st M_2 about as long as vein M_3 beyond it; basal section of M_3 longer than m; m-cu more than one-fourth its length before the fork of M.

Abdomen, including hypopygium, yellow. Male hypopygium (Plate 2, fig. 26) with the tergite narrowly transverse, the caudal margin approximately straight across or with the median portion a little projecting. Outer dististyle, *od*, relatively long and slender, at apex suddenly narrowed into an acute darkened spine. Inner dististyle broader, the apex obtuse. Phallosome, *p*, subtended on either side by a flattened, very pale plate, the apex of which is obtusely rounded. Outer gonapophysis, *g*, a simple slender rod, gradually narrowed to an acute point.

Habitat.—China (Hainan Island).

[3] Journ. Fed. Malay St. Mus. 14 (1928) 74–80.

Holotype, male, Dwa Bi, altitude about 1,500 feet, July 21, 1935 (*Gressitt*).

The present species is most closely allied to *Antocha* (*Antocha*) *flavella* Edwards and *A.* (*A.*) *nebulosa* Edwards, both from the Malay Peninsula, differing in the gray coloration of the head, color of the antennæ, uniformly yellow thorax and abdomen, darkened femoral tips, and details of pattern of the wings. In the last-mentioned regard, the fly is more like *nebulosa*, which in all other respects is very distinct.

ANTOCHA (ANTOCHA) KHASIENSIS sp. nov. Plate 1, fig. 8; Plate 2, fig. 27.

General coloration pale yellow, the transverse suture of mesonotum narrowly darkened; antennæ yellow; legs yellow, the tips of femora rather narrowly but conspicuously blackened; wings milky white, patterned with brownish black, including the prearcular field and subcostal cell as far distad as the level of origin of Rs; cord and outer end of cell 1st M_2 narrowly seamed with dark; m-cu more than its own length before the fork of M; male hypopygium with the outer dististyle obtuse at apex; inner gonapophysis acutely pointed, with a pale lateral flange.

Male.—Length, about 3.5 to 3.7 millimeters; wing, 4 to 4.4.

Female.—Length, about 3.5 millimeters; wing, 4.

Rostrum yellow; palpi scarcely darkened. Antennæ short, yellow, the outer flagellar segments a trifle darker; flagellar segments oval. Head yellow.

Mesonotum pale yellow, the suture narrowly dark brown, the pattern a little more expanded at lateral ends. Pleura pale yellow. Halteres pale yellow throughout. Legs yellow, the tips of the femora narrowly but conspicuously blackened, the amount subequal on all legs; in the allotype the femora are somewhat less extensively darkened; tibiæ more narrowly darkened at tips; tarsi yellow, the outer segments darker. Wings (Plate 1, fig. 8) milky white, patterned with brownish black, in the costal field the latter color alternating with brighter yellow areas, most evident on the costal vein before and beyond the dark stigma; prearcular field and cell Sc as far distad as the origin of Rs blackened; cord and outer end of cell 1st M_2 seamed with blackish; veins pale, darker in the clouded areas, including the outer medial veins. Venation: R_{2+3} only a little longer than R_2, the latter lying far before the level of r-m; m-cu more than its own length before the fork of M.

Abdomen, including hypopygium, yellow. Male hypopygium (Plate 2, fig. 27) with the outer dististyle, *od*, short, and unusual-

ly obtuse at apex. Inner gonapophysis, *g*, terminating in an acute spinous point, the outer margin back from the point expanded into a pale flange that is wider towards the base.

Habitat.—Assam (Khasi Hills).

Holotype, male, Cherrapunji, altitude 4,000 feet, August, 1935 (*Sircar*). Allotopotype, female. Paratopotypes, 2 males.

Antocha (*Antocha*) *khasiensis* is most nearly related to *A.* (*A.*) *nigribasis* Alexander (western China), differing most conspicuously in the small size and structure of the male hypopygium. It is readily told from all other previously described species of the Himalayan and Indo-Malayan regions by the extreme basal position of m-cu and the coloration of the body, legs, and wings.

I am greatly indebted to Mr. S. Sircar for the following data on the conditions under which the present series of Tipulidæ were collected. "The specimens were collected by me personally at light (400 C. P. Petromax). It was showering very mildly and from my experience I can say that this is the best time for collecting Tipulidæ at light. Hundreds of these flies came to the light, but I could not save all of them as my net got wet and I had to catch them by hand as they rested on a cloth hung up by the side of the light."—S. SIRCAR.

HEXATOMINI

PSEUDOLIMNOPHILA CONCUSSA sp. nov. Plate 1, fig. 9; Plate 2, fig. 28.

General coloration brownish gray; antennæ black; wings relatively narrow, almost uniformly tinged with brownish yellow; costal fringe short; Rs long, subequal to vein R_3; R_2 at or close to fork of R_{3+4}; cell M_1 present; cell 1st M_2 long and narrow, subequal to vein M_4 beyond it; m-cu at or close to fork of M.

Male.—Length, about 7 millimeters; wing, 6.8.

Female.—Length, about 8 millimeters; wing; 7.5.

Rostrum dark; palpi black. Antennæ brownish black to black throughout, or (male) with the basal half of first flagellar segment paler; flagellar segments subcylindrical to cylindrical, with long conspicuous verticils. Head brownish gray; anterior vertex and orbits clearer gray.

Pronotum dark brownish gray. Mesonotum brownish gray, the præscutum with a slightly darker median stripe, somewhat more intense on cephalic portion; pseudosutural foveæ black. Pleura gray, variegated by more blackish gray on ventral anepisternum, sternopleurite, and meron. Halteres pale, the knobs infuscated. Legs with the fore coxæ blackened, heavily pruinose; middle and hind coxæ much paler; trochanters testaceous-

yellow; remainder of legs brownish yellow or, in cases, the femora more yellowish brown. Wings (Plate 1, fig. 9) relatively narrow, as compared to *inconcussa,* almost uniformly tinged with brownish yellow; stigma very faintly darker; veins darker brown. Costal fringe short in both sexes; Venation: Sc_1 ending opposite or just before fork of Rs, Sc_2 at its tip; Rs long, nearly straight to very gently arcuated at origin; R_{2+3+4} elongate, only a little shorter than vein R_3; R_2 at or very close to fork of R_{3+4}; R_{1+2} from one and one-half to twice the length of R_2; cell M_1 present, about as long as its petiole; cell 1st M_2 relatively long and narrow, its inner end arcuated, the lower face of the cell subequal to or even longer than vein M_4; m-cu at or just beyond fork of M; anterior arculus present.

Abdomen dark brown, sparsely pruinose, the hypopygium a trifle brighter. Male hypopygium (Plate 2, fig. 28) with the outer dististyle, *od,* a little longer than the inner style, *id,* straight, its apex decurved into a slender spine; inner margin before apex with a few denticles. Interbasal rods slender, each with a low obtuse flange at near midlength.

Habitat.—China (Hainan Island).

Holotype, male, Ta Hian, altitude 2,000 feet, June 14, 1935 (*Gressitt*). Allotype, female, Dwa Bi, altitude about 1,500 feet, July 21, 1935 (*Gressitt*).

Pseudolimnophila concussa is very closely allied to *P. inconcussa* (Alexander), of Japan and China, and may prove to be only a more southern race of the latter. The unusually narrow wings, with narrow cell 1st M_2 serve to separate the fly from the usually larger and more vigorous *inconcussa.*

PSEUDOLIMNOPHILA SETICOSTATA sp. nov. Plate 1, fig. 10.

General coloration of mesonotum uniformly dark brown, the pleura a little paler; antennæ black throughout; flagellar verticils very long; legs brownish black; wings a faint brown tinge; costal fringe (male) unusually long and dense; R_2 at or before fork of R_{3+4}; cell M_1 lacking; m-cu a short distance beyond fork of M; abdominal tergites dark brown, the sternites more brownish yellow.

Male.—Length, about 5 millimeters; wing, 5.5.

Rostrum obscure yellow to yellowish brown; palpi black. Antennæ black throughout; flagellar segments subcylindrical, with long verticils that greatly exceed the segments. Head brownish black above, the anterior vertex and orbits a very little paler; anterior vertex relatively wide, exceeding twice the diameter of scape.

Pronotum and mesonotum almost uniformly dark brown, the pleura a little paler. Halteres dusky, the base of stem very narrowly paler. Legs with the coxæ brown; trochanters yellowish brown; remainder of legs brownish black. Wings (Plate 1, fig. 10) with a faint brownish tinge; stigma oval, slightly darker brown; veins medium brown, much darker than the ground. Costal fringe (male) unusually long and dense, the setæ longer than the width of cell Sc_1. Venation: Sc_1 ending shortly before level of fork of Rs, Sc_2 near its tip; R_2 variable in position, in the paratype being some distance before the fork of R_{3+4}, veins R_{1+2}, R_2, and R_{3+4} in this case being subequal in length; in the holotype R_2 is at or very close to the fork of R_{3+4}, eliminating or greatly reducing the latter element; veins R_3 and R_4 diverging rather conspicuously, cell R_3 at margin being considerably more extensive than cell R_2; cell M_1 lacking; m-cu a short distance beyond fork of M; anterior arculus present.

Abdominal tergites dark brown, the sternites and hypopygium more brownish yellow.

Habitat.—China (Hainan Island).

Holotype, male, Ta Han, altitude 2,500 feet, June 21, 1935 (*Gressitt*). Paratype, male, Dwa Bi, altitude about 1,500 feet, July 22, 1935 (*Gressitt*).

The long dense costal fringe of the male (though possibly not of the still unknown female) is much like that of the otherwise very distinct *P. costofimbriata* Alexander, of southern India, the latter species having cell M_1 present and very deep. *Pseudolimnophila descripta* Alexander, of the mountains of Formosa, has cell M_1 lacking, but differs from the present fly in other venational details. The female sex of the latter species has the costal fringe short, but the male is still unknown.

Genus HEXATOMA Latreille

Hexatoma LATREILLE, Gen. Crust. et Ins. 4 (1809) 260.

Subgenus EUHEXATOMA novum

Characters as in the subgenus *Eriocera* Macquart, having four branches of radius and four of media reaching the wing margin; cell 1st M_2 closed. Supernumerary crossveins in each of cells R_3, R_4, and R_5 in approximate alignment (Plate 1, fig. 11).

Type of subgenus.—*Hexatoma* (*Euhexatoma*) *triphragma* sp. nov. (Oriental Region: Eastern China, Hainan Island).

The new subgenus is based on the presence of three strong supernumerary crossveins in the outer radial field of the wing, a character paralleled by other subgeneric groups in the allied

hexatomine genera *Adelphomyia* Bergroth and *Limnophila* Macquart. The present fly is of very strange appearance, the outer radial field giving one a definite impression of resemblance to the wing of a scorpion fly (Mecoptera).

HEXATOMA (EUHEXATOMA) TRIPHRAGMA sp. nov. Plate 1, fig. 11.

General coloration of thorax brownish yellow, the præscutum with three confluent darker brown stripes; antennal flagellum yellow; femora yellow, the tips narrowly blackened; wings dark brown, the veins narrowly but conspicuously bordered by yellow; wing tip more broadly yellowish; small paired hyaline droplets near outer ends of cells R_4 and R_5, respectively; supernumerary crossveins in cells R_3, R_4, and R_5; cell M_1 present; m-cu at near two-thirds the length of cell 1st M_2; abdominal tergites reddish brown, the hypopygium brownish yellow.

Male.—Length, about 20 millimeters; wing, 16.

Rostrum dark brown; palpi short, brown. Antennæ 7-segmented; scape and pedicel yellowish brown; flagellum yellow, the outer segments a little darkened; flagellar segments cylindrical, gradually decreasing in length outwardly. Head brown; vertical tubercle entire, its margin rounded.

Pronotum brown. Mesonotal præscutum brownish yellow, with three darker brown stripes that are confluent behind; posterior sclerites of notum chiefly brownish black. Pleura obscure yellow, variegated by dark brown on the ventral anepisternum, ventral sternopleurite, meron, and pleurotergite. Halteres brownish yellow. Legs with the coxæ light brown, trochanters more reddish brown; femora yellow, the tips narrowly blackened, the amount subequal on all legs and including about the distal sixth or seventh of the segment; tibiæ brown, the tips narrowly blackened; tarsi black. Wings (Plate 1, fig. 11) with the ground color dark brown, the veins narrowly but conspicuously bordered by yellow; wing tip more extensively of the same color; two small paired hyaline droplets near outer ends of cells R_4 and R_5, beyond the supernumerary crossveins of these cells; cell 1st A more grayish, cell 2d A yellow, margined outwardly with gray; vague linear pale streaks in central portions of cells R_1, M, and M_4; veins yellow to brownish yellow, contrasting with the dark ground. Scattered macrotrichia on all outer radial branches. Venation: Sc_1 ending about opposite R_2; R_{2+3+4} a little shorter than the basal section of R_5; R_{1+2} longer than R_{2+3+4}; the supernumerary crossveins in the radial field slightly variable in position, those in cells R_3 and R_4 more oblique

than the one in cell R_5; in the left wing of type, the vein in cell R_3 lies more than its own length beyond the one in cell R_5, whereas in the right wing the elements are nearly interstitial, as illustrated; cell M_1 present; m-cu much longer than the distal section of Cu_1, placed at near two-thirds the length of cell 1st M_2.

Abdominal tergites deep reddish brown, without differentiated basal coloring on the individual segments; basal and subterminal segments somewhat darker; sternites clearer reddish brown; hypopygium brownish yellow.

Habitat.—China (Hainan Island).

Holotype, male, Liamui, altitude about 1,200 feet, July 31, 1935 (*Gressitt*).

This rather remarkable crane fly requires no comparison with any previously described member of the genus, the subgeneric character of three supernumerary crossveins in the outer radial field being quite unique within the group.

HEXATOMA (ERIOCERA) TUBERCULATA sp. nov. Plate 1, fig. 12.

Belongs to the *perennis* group; general coloration of thorax dull gray, the præscutum with four scarcely differentiated plumbeous-gray stripes that are narrowly bordered by blackish; setæ of thoracic dorsum short and inconspicuous; a median series of from three to five small tubercles at cephalic portion of præscutum; halteres and legs black; wings dark brown, with an oval yellow discal area before cord; costal vein in both sexes with abundant short setæ; cell M_1 present; abdominal tergites purplish blue, with about the outer third of the segments dull black; hypopygium and shield of ovipositor orange.

Male.—Length, about 19 to 24 millimeters, wing, 15 to 19.

Female.—Length, about 24 to 25 millimeters; wing, 16 to 17.

Rostrum dark gray; palpi black. Antennæ short in both sexes, in male 7-segmented, in female 11-segmented; scape and pedicel black, sparsely pruinose; flagellum obscure yellow to yellowish brown. Head dull black, a little more grayish on front and on posterior orbits; vertical tubercle entire, unusually slender, especially in male. Vestiture of head of moderate length.

Pronotum dull dark gray, the lateral angles of the scutum produced into tuberculate lobes; scutellum with a deep median incision on anterior border. Mesonotal præscutum dull gray, with four scarcely differentiated plumbeous-gray stripes that are narrowly bordered by blackish; anteromedian portion of præscutum elevated into from three to five small tubercles arranged in a longitudinal row; posterior sclerites of notum dull plumbeous-gray. Vestiture of thoracic dorsum unusually short and sparse.

Pleura entirely blackened, very sparsely pruinose. Halteres short, black throughout. Legs entirely black. Wings (Plate 1, fig. 12) dark brown, the anal cells a little paler; an oval yellow discal area before the cord, occupying the outer end of cell R and adjoining parts of cells R_1 and M, with a slight invasion of the extreme base of cell 1st M_2; veins dark reddish brown, brighter in the yellow area; some of the veins adjoining the discal brightening very narrowly and insensibly bordered by yellow. Costa with abundant small setæ in both sexes; outer branches of R with trichia, more sparse and scattered on R_5; a few scattered trichia on vein M_1 and, in cases, on M_2. Venation: Sc_1 ending shortly beyond R_2; Rs angulated to spurred very close to origin; R_{1+2} much longer than R_{2+3+4}, the latter subequal to basal section of R_5; cell M_1 present; m-cu at near two-thirds to three-fourths the length of cell 1st M_2.

Abdominal tergites two to seven, inclusive, brilliant purplish blue, the caudal margins of the segments dull black, involving about the outer third of the sclerite; sternites more uniformly blackened, the basal rings less brilliantly blue; male hypopygium and shield of ovipositor orange.

Habitat.—China (Hainan Island).

Holotype, male, Fan Ta, altitude about 1,250 feet, June 3, 1935 (*Gressitt*). Allotype, female, Ta Hian, altitude 2,000 feet, June 11, 1935 (*Gressitt*). Paratypes, 2 males, with the allotype, June 12 and 13, 1935; 1 male, 1 female, Liamui, altitude about 1,200 feet, August 1 and 2, 1935 (*Gressitt*).

By Edwards's key to the Old World species of *Eriocera*,[4] the present fly runs to couplet 87, disagreeing with species beyond this point by the lack of yellow or orange areas on the intermediate abdominal segments, as well as in several other features. The fly is quite distinct from all other species known to me.

HEXATOMA (ERIOCERA) HIRTITHORAX sp. nov. Plate 1, fig. 13.

General coloration deep velvety black; head and thorax with long, coarse, erect setæ; halteres and legs black; wings strongly blackened, with a narrow white discal area before the cord; numerous macrotrichia on veins beyond cord; cell M_1 lacking; m-cu beyond outer end of cell 1st M_2 on vein M_4; abdomen velvety black, segments two, four, and five with leaden-colored basal bands; genital shield black; valves of ovipositor orange.

Female.—Length, about 16 millimeters; wing, 12.5.

[4] Ann. & Mag. Nat. Hist. IX 8 (1921) 70–78.

Rostrum black, sparsely pruinose; palpi black. Antennæ (female) 11-segmented; scape and pedicel black; flagellum brownish black, the incisures of the more proximal segments narrowly paler; flagellar segments with long coarse verticils; segments gradually decreasing in length outwardly, the terminal a little longer than the penultimate. Head dark gray, with very long, coarse, black setæ.

Thorax uniformly velvety black, with long coarse setæ, especially conspicuous on the dorsum. Halteres and legs black throughout. Wings (Plate 1, fig. 13) strongly blackened, the anal cells much paler, grayish; a narrow white discal area before cord, including cells R_1 to Cu, inclusive, the last area narrowly separated from the remainder of the band by a narrow dark seam adjoining vein Cu in cell M; the gray anal cells variegated by more infuscated area at near midlength and by more brightened areas near outer end of cell 1st A and basal portion of cell 2d A; veins dark, paler in the discal brightening. Costal fringe short but abundant, longer and more conspicuous basad of h; macrotrichia of veins beyond cord abundant, including all veins from R_{1+2} to Cu_1, inclusive, more sparse and restricted in the medial and cubital fields. Venation: Sc_1 ending nearly opposite R_2; R_{1+2} much longer than either R_{2+3+4} or R_{2+3}; medial veins very faint and difficult to trace; cell M_1 lacking; m-cu erect, placed beyond the outer end of cell 1st M_2 on vein M_4.

Abdomen velvety black, segments two, four, and five with leaden-colored or plumbeous basal bands, segments three, six, and seven uniformly blackened; sternites black; genital shield black; valves of ovipositor orange.

Habitat.—China (Hainan Island).

Holotype, female, Liamui, altitude about 1,200 feet, July 31, 1935 (*Gressitt*).

Hexatoma (*Eriocera*) *hirtithorax* is one of rather numerous species discovered in recent years that runs to *H.* (*E.*) *hilpa* (Walker) by means of existing keys to the subgenus. It is distinguished from allies in this particular group of forms by the coloration of the wings and abdomen, the venation, as the deep fork of cell R_3 and direction and position of m-cu, and by the unusually long erect pubescence of the head and thorax. In the latter feature the species agrees well with *H.* (*E.*) *villosa* Edwards (Perak), which has an apical pale crescent on the wings, additional to the pale discal area.

ELEPHANTOMYIA (ELEPHANTOMYODES) ANGUSTICELLULA sp. nov. Plate 1, fig. 14.

General coloration of mesonotum brownish yellow, the pleura a trifle more infuscated; rostrum approximately one-half as long as remainder of body; basitarsus with proximal two-thirds black, the distal third snowy white; wings subhyaline; cell Sc, stigma and outer end of cell R_2 uniformly and continuously infuscated; basal section of R_5 almost in longitudinal alignment with Rs; cell 2d A very short and narrow; abdominal tergites inconspicuously bicolorous, obscure yellow, the caudal portions of the segments blackened, the outer three segments uniformly blackened.

Male.—Length, excluding rostrum, about 10 millimeters; wing, 6.5; rostrum alone, 5.

Rostrum black throughout, approximately one-half as long as remainder of body. Antennæ black; flagellar verticils long and conspicuous. Head brown, the orbits narrowly light gray; anterior vertex relatively wide, a little greater than the diameter of scape.

Mesonotum uniformly dull brownish yellow, the pleura a trifle more infuscated. Halteres obscure, the knobs a trifle more dusky. Legs with the coxæ weakly infuscated; trochanters brownish yellow; femora brownish black, a little brightened basally, deepening to black at tips; tibiæ black; basitarsi black, the distal third snowy white; remainder of tarsi snowy white, the terminal segment infumed. Wings (Plate 1, fig. 14) subhyaline, cell Sc, stigma and adjoining narrowed outer portion of cell R_2 uniformly and continuously infuscated; veins black. Venation: Rs strongly arcuated; anterior branch of Rs at origin arcuated in almost the same degree as Rs, its distal portion gently sinuous and running close to R_1; basal section of vein R_5 almost in longitudinal alignment with the end of Rs, a little shorter than r-m; cell 1st M_2 longer than vein M_4 beyond it; m-cu about one-half its length beyond the fork of M; cell Cu gradually widened to margin; vein 2d A short, the cell unusually short and narrow.

Abdominal tergites obscure yellow, blackened medially and caudally, the outer three segments uniformly blackened; sternites more uniformly obscure yellow, the caudal portions of the segments more infuscated.

Habitat.—China (Hainan Island).

Holotype, male, Ta Han, altitude 2,000 feet, June 7, 1935 (*Gressitt*).

Elephantomyia (*Elephantomyodes*) *angusticellula* is generally similar to several other species of the subgenus in the Oriental and eastern Palæarctic faunal regions, such as *E.* (*E.*) *aurantia* (Brunetti), *E.* (*E.*) *fuscomarginata* Enderlein, and *E.* (*E.*) *uniformis* Alexander, differing from all in the body coloration and the details of venation, especially the very short and narrow cell 2d A. In the last-mentioned regard, the nearest approach to the present fly is found in *uniformis*.

ERIOPTERINI

TRENTEPOHLIA (MONGOMA) HAINANICA sp. nov. Plate 1, fig. 15.

Thorax entirely orange-yellow, immaculate; antennæ black throughout; femora obscure yellow basally, passing into brown; tibiæ dark brown; tarsi paling to yellowish brown; wings whitish subhyaline, the prearcular and costal regions clear light yellow; a restricted dark pattern, including the wing tip and a seam along vein Cu_1; R_2 at or beyond the fork of R_{2+3+4}; abdomen black, the bases of the intermediate segments vaguely brightened.

Male.—Length, about 9 millimeters; wing, 7.2.

Female.—Length, about 11 millimeters; wing, 8.5.

Rostrum brown; palpi black. Antennæ black throughout; flagellar segments cylindrical, the verticils shorter than the segments. Head brownish yellow; anterior vertex reduced to a narrow strip, carinate, the ridge extending caudad onto the posterior vertex.

Pronotum yellow. Mesonotum and pleura entirely deep orange-yellow, immaculate. Halteres with basal third of stem obscure yellow, the outer portion and knob blackened. Legs with the coxæ and trochanters yellow; femora obscure yellow basally, passing into brown, the tips gradually deepening to dark brown; tibiæ dark brown; tarsi paling to yellowish brown; bases of femora with a series of from eight to ten small black spines; posterior tibiæ near apex with about four powerful black setæ, the outermost shorter. Wings (Plate 1, fig. 15) whitish subhyaline, the prearcular and costal regions clear light yellow; stigma dark brown; paler brown washes include the extensive wing tip, vague seams along cord, a broad, conspicuous seam in cell M adjoining vein Cu, and the axillary region; veins brownish black, luteous in the yellow basal and costal portions. Venation: R_2 at or beyond fork of R_{2+3+4}; m-cu at or before (male) fork of M; apical fusion of veins Cu_1 and 1st A slight; cell 2d A wide.

Abdomen black, the bases of the intermediate tergites very vaguely brightened by brownish yellow; genitalia of both sexes obscure yellow.

Habitat.—China (Hainan Island).

Holotype, male, Ta Han, altitude 2,500 feet, June 22, 1935 (*Gressitt*). Allotopotype, female, June 23, 1935 (*Gressitt*).

Trentepohlia (*Mongoma*) *hainanica* is allied to *T.* (*M*). *auricosta* Alexander and *T.* (*M.*) *flavicollis* Edwards, of Java, especially to the former. The differently patterned thorax, legs, and wings, and the uniformly darkened halteres, readily separate the present fly from these somewhat similar species. By my latest key to the Philippine species of *Trentepohlia,*[5] the fly runs to *T.* (*M.*) *carbonipes* Alexander, of Mindanao, a very different fly.

GONOMYIA (PTILOSTENA) HAINANENSIS sp. nov. Plate 1, fig. 16.

General coloration of mesonotum dark brown, more reddish brown on sides; knobs of halteres darkened; femora yellow, with a narrow but conspicuous brownish black ring just before apex; wings yellow, sparsely patterned with dark brown; stigma oval, extending distad to vein R_3; vein R_4 gently arcuated; abdominal tergites black, the caudal margins narrowly yellow.

Female.—Length, about 5.5 millimeters; wing, 5.

Rostrum and palpi dark. Antennæ with scape brownish yellow; pedicel yellow; flagellum broken. Head brownish gray.

Pronotum obscure yellow above, darker on sides. Lateral pretergites light yellow. Mesonotal præscutum dark brown medially, more reddish brown on sides, the humeral region with a very restricted area of light yellow; pseudosutural foveæ brownish black; scutum dark brown; scutellum testaceous-brown; mediotergite dark, with a pruinose gray triangle on cephalic portion, the point directed backward. Pleura reddish brown, the dorsal sclerites somewhat darker. Halteres pale, the knobs darkened. Legs with the coxæ testaceous-brown; trochanters testaceous-yellow; femora yellow, with a narrow but conspicuous brownish black ring just before apex; tibiæ obscure yellow, the tips narrowly blackened; tarsi brownish yellow, darker outwardly. Wings (Plate 1, fig. 16) with the ground color yellow, sparsely patterned with dark brown, the areas including a small arcular darkening, origin of Rs, cord and m-cu, stigma, and a

[5] Philip. Journ. Sci. **53** (1934) 442–444.

paler brown submarginal wash in outer ends of cells R_3 and R_4; no darkening at outer end of vein 2d A; wing tip deeper yellow than the remainder of ground; stigmal area oval, extending distad to vein R_3 or virtually so; veins yellow, darker in the infuscated areas. Costal fringe relatively long and conspicuous; numerous macrotrichia on all veins beyond level of m-cu and on veins M and 1st A nearer the wing base. Venation: Sc_1 ending about opposite one-fourth the length of the strongly angulated to weakly spurred Rs; R_{1+2} and R_3 close together at wing margin; vein R_4 gently arcuated, not strongly recurved as in *teranishii* and allies; medial fork about one-third longer than its petiole; m-cu less than twice its length before fork of M.

Abdominal tergites black, the caudal margins of the segments narrowly but conspicuously yellow; sternites more brownish yellow, the yellow apices not so clearly defined.

Habitat.—China (Hainan Island).

Holotype, female, Ta Han, altitude 2,500 feet, June 21, 1935 (*Gressitt*).

The nearest described allies are *Gonomyia* (*Ptilostena*) *longipennis* Alexander (Loochoo Islands) and *G.* (*P.*) *teranishii* Alexander (Japan, eastern and southern China), which differ in the coloration of the body, the uniformly pale femora, and the details of wing pattern and venation, notably the more strongly arcuated vein R_4.

GONOMYIA (LIPOPHLEPS) CONQUISITA sp. nov. Plate 1, fig. 17.

Belongs to the *sulphurella* group; allied to *nubeculosa;* general coloration of notum dark gray; scutellum obscure yellow, darkened medially at base; femora yellow, with a narrow, dark brown, subterminal ring, the yellow apex subequal in extent or slightly wider; wings tinged with grayish, the costal border and apex whitened; abdominal tergites black, the caudal borders of the segments narrowly yellow.

Female.—Length, about 5 millimeters; wing, 4.

Rostrum and palpi black. Antennæ with scape and pedicel yellow above, darker on lower surface; flagellum broken. Head above obscure yellow, the central portion of posterior vertex more infuscated, its sides and the genæ again darkened.

Pronotum yellow, darker on sides; pretergites light yellow. Mesonotal præscutum and scutum dark gray; pseudosutural foveæ dark red, inconspicuous against the ground; scutellum obscure yellow, the basal portion darkened medially; postnotum gray. Pleura brownish black, with a conspicuous, whitish, longitudinal stripe extending from the fore coxæ to the base of

abdomen; ventral sternopleurite and meron darkened; pteropleurite and pleurotergite somewhat paler brown than the anterior sclerites. Halteres yellow, the knobs weakly darkened basally. Legs with the fore coxæ whitened, middle and posterior coxæ darker basally, the tips pale; femora yellow, with a narrow, dark brown, subterminal ring, this subequal to or narrower than the yellow apex; tibiæ yellow; tarsi broken. Wings (Plate 1, fig. 17) with a grayish tinge, the costal border and apex whitened, the latter including the distal ends of cells R_4, R_5, and 2d M_2 as far basad as the level of the tip of vein R_4; stigma small, oval, brown, interrupting the white costal border; restricted darker areas at arculus, origin of Rs, along cord and outer end of cell 1st M_2, and as a seam on vein R_3; veins pale, darker in the infuscated areas, more whitened in the pale portions of the wing. Costal fringe pale, relatively long and conspicuous; rather numerous macrotrichia on veins R_{2+3+4}, R_4, distal section of R_5, and distal sections of M_{1+2} and M_3; a few trichia at extreme outer end of vein 2d A. Venation: Sc_1 ending opposite origin of the long Rs, Sc_2 close to its tip; Rs subequal in length to stem of cell R_3; vein R_3 very short, perpendicular; cell R_2 at margin considerably more extensive than cell R_3; vein R_4 rather strongly upcurved at margin; m-cu shortly before fork of M.

Abdominal tergites black, the caudal borders of the segments narrowly yellow; sternites somewhat more grayish black, the pale borders narrower. Cerci horn-colored, darkened basally.

Habitat.—China (Hainan Island).

Holotype, female, Ta Han, altitude 2,500 feet, June 21, 1935 (*Gressitt*).

Gonomyia (*Lipophleps*) *conquisita* is readily told from other members of the group that are closely allied to *nubeculosa* (de Meijere), including *pallidisignata* Alexander, by the narrow brown femoral rings. In all species of the group hitherto described, these annuli are black, very broad, and preceded and followed by narrow whitened rings.

GONOMYIA (LIPOPHLEPS) PALLICOSTATA sp. nov. Plate 1, fig. 18; Plate 2, fig. 29.

Allied to *bicolorata;* femora brown, the extreme tip abruptly pale; wings suffused with brown, the costal and apical portions narrowly white, the remainder of membrane more or less variegated by paler areas; stigma oval, dark brown; Sc short, Sc_1 ending before origin of Rs a distance nearly equal to the length of the latter vein; male hypopygium with two dististyles, the outer one bilobed, its outer arm a long, slender, simple rod, the

inner arm a densely hairy cushion; inner style terminating in a curved spine and bearing a second, very long spine on outer margin at near midlength.

Male.—Length, about 3.2 to 3.4 millimeters; wing, 3.5 to 3.8.

Female.—Length, about 4 millimeters; wing, 4.

Rostrum and palpi black. Antennæ with the scape and pedicel yellow, flagellum black; flagellar segments (male) with unusually elongate verticils. Head chiefly yellow; badly flexed in types, but apparently with central darkening on posterior vertex.

Pronotum and lateral pretergites pale yellow, the former darkened on sides. Mesonotal præscutum and scutum almost uniformly dark brown, the pseudosutural foveæ black; scutellum black basally, obscure brownish yellow behind; mediotergite blackened, the anterolateral portions obscure yellow. Pleura chiefly dark brown, somewhat paler dorsally on the pteropleurite and pleurotergite, and ventrally on the ventral sternopleurite; a broad white longitudinal stripe extends from the fore coxæ across the dorsal sternopleurite, ventral pteropleurite, and meral area to base of abdomen. Halteres yellow, the lower face of knob dusky. Legs with the coxæ pale, their basal portions dark brown, the fore coxæ more uniformly whitened; trochanters testaceous-yellow; femora brown, somewhat darker outwardly, the extreme tip abruptly pale; tibiæ and tarsi brown. Wings (Plate 1, fig. 18) almost uniformly suffused with brown, the costal border and apex conspicuously china white, the degree nearly uniform throughout the area except before the stigma where the pale crosses Rs into cell R; stigma oval, dark brown; dusky ground color slightly variegated by paler areas, as in many allied forms; veins brownish yellow, paler, almost white, in the anterior pale portion. Costal fringe sparse, but long and conspicuous. Venation: Sc short, Sc_1 ending far before origin of Rs, the distance on costa nearly as long as Rs alone; branches of Rs divergent; cell R_5 narrowed at margin; m-cu a short distance before fork of M.

Abdominal tergites dark brown, the posterolateral angles yellow, more broadly and conspicuously so on outer segments; subterminal segment more uniformly darkened; hypopygium yellowish brown. Male hypopygium (Plate 2, fig. 29) with two terminal dististyles; outer style, *od,* bilobed, the outer arm a simple, slender, blackened rod, a little longer than the basistyle; inner lobe more than one-half as long as the outer, fleshy, the distal half with abundant yellow setæ. Inner dististyle, *id,*

small, terminating in a slender, curved, acute spine; on outer margin at near midlength produced into a second, very long, nearly straight spine that exceeds the style in length, its base dilated. Phallosome, *p*, with two divergent subapical lobes, the tips with microscopic setæ.

Habitat.—China (Hainan Island).

Holotype, male, Ta Han, altitude 2,500 feet, June 23, 1935 (*Gressitt*). Allotype, female, Ta Hian, altitude 2,000 feet, June 19, 1935 (*Gressitt*). Paratype, male, Liamui, altitude about 1,200 feet, August 3, 1935 (*Gressitt*).

The nearest described ally is *Gonomyia* (*Lipophleps*) *bicolorata* Alexander (Luzon, Hainan), which is similar in general appearance, but the structure of the male hypopygium is very different.

GONOMYIA (LIPOPHLEPS) PULVINIFERA sp. nov. Plate 1, fig. 19; Plate 2, fig. 30.

Mesonotum brownish black, sparsely pruinose; scutellum yellow, darkened medially at base; thoracic pleura with a longitudinal yellow stripe; femora infuscated, with a broad, blackish, subterminal ring, preceded and followed by narrow, clearer yellow annuli; tibiæ and tarsi black; wings grayish subhyaline, the costal border whitened, the disk with extensive brown clouds; Sc short; male hypopygium with the outer dististyle a long blackened rod, its distal fifth expanded and densely set with a cushion of spines.

Male.—Length, about 3.5 millimeters; wing, 3.6 to 3.7.

Rostrum obscure brownish yellow; palpi black. Antennæ black, the scape more or less brightened. Head orange-yellow, variegated by brownish black on central portion of disk.

Mesonotum brownish black, sparsely pruinose; pseudosutural foveæ black; scutellum yellow, darkened medially at base; postnotum more heavily pruinose. Pleura brownish black, the dorsal pteropleurite and pleurotergite more infuscated; a relatively narrow but conspicuous, pale yellow, longitudinal stripe extending from the fore coxæ to the base of abdomen, passing beneath the root of halteres, this stripe narrowly bordered dorsally by a dark stripe. Halteres yellow, most of the knobs infuscated. Legs with the coxæ darkened basally, paler at tips; trochanters brownish testaceous; femora infuscated, the distal third more yellowish, inclosing a broad, more-blackened subterminal ring, the actual tip and postmedian pale annulus much narrower; posterior femora with long erect setæ; tibiæ and tarsi brownish black. Wings (Plate 1, fig. 19) with the ground color grayish subhyaline, variegated by more brownish clouds near wing base,

across outer ends of cells R to 1st A, inclusive, and beyond the cord; costal border and conspicuous areas before and beyond stigma white; stigma oval, pale brown; veins pale brown, still paler in the brightened costal portions, darker along cord. Costal fringe relatively long and conspicuous; trichia of veins beyond cord relatively abundant. Venation: Sc short, Sc_1 ending some distance before origin of Rs, the distance on C being about two-thirds the length of Rs alone; r-m long, gently arcuated.

Abdomen blackened, the caudal borders of both tergites and sternites restrictedly paler; hypopygium large, more chestnut-brown, the conspicuous outer dististyle black. Male hypopygium (Plate 2, fig. 30) with the two dististyles terminal in position. Outer dististyle, *od,* a long, nearly straight, blackened rod that is considerably longer than the basistyle, on apical fifth a little dilated and bearing a dense brush or cushion of spines; outer surface of stem of style with abundant spinous points or teeth. Inner dististyle, *id,* small, simple, long, and slender. Phallosome, *p,* not clearly evident in material studied, consisting of flattened pale cushions and a single, acute, smooth black spine.

Habitat.—Assam (Khasi Hills).

Holotype, male, Cherrapunji, altitude 4,000 feet, August, 1935, at light (*Sircar*). Paratopotype, 2 males.

By Edwards's key to the Oriental species of *Lipophleps,*[6] the present fly runs to *subnebulosa* Edwards, a quite different species with the wing pattern distinct. As usual in the genus, the male hypopygium offers the chief feature for the separation of the species from allied forms.

GONOMYIA (LIPOPHLEPS) SIRCARI sp. nov. Plate 1, fig. 20; Plate 2, fig. 31.

General coloration dark brownish gray; scutellum obscure yellow on posterior border; pleura with a light yellow longitudinal stripe; legs dark brown; posterior femora with a series of more than a score of erect setæ; wings with a faint brown tinge, the disk slightly variegated by more grayish subhyaline areas; Sc short; male hypopygium with the outer dististyle a simple rod; inner dististyle bearing two long, slender, pale arms, each tipped with a small blackened spine; phallosome with appressed spinulose points.

Male.—Length, about 3 millimeters; wing, 3.3.

Rostrum and palpi black. Antennæ black throughout. Head above orange-yellow, the central portion of vertex more darkened.

[6] Journ. Fed. Malay St. Mus. 14 (1928) 104–105.

Pronotum and anterior lateral pretergites yellow. Mesonotal præscutum and scutum uniformly dark brownish gray, without markings; scutellum obscure yellow on the posterior border, broadly darkened medially at base; postnotum obscure yellow on cephalic half, the posterior portion darkened. Pleura with the dorsopleural membrane and most of pteropleurite and pleurotergite obscure yellow, the more ventral pleurites brownish gray, with a conspicuous light yellow longitudinal stripe extending from and including the fore coxæ, reaching the base of abdomen. Halteres dusky, with most of the knob light yellow. Legs with the fore coxæ yellow, the remaining coxæ and all trochanters more testaceous; remainder of legs dark brown; posterior femora with an evenly spaced series of more than a score of long erect setæ, additional to the usual appressed vestiture. Wings (Plate 1, fig. 20) with a faint brownish tinge, the prearcular and costal portions more clearly yellow; stigma small, oval, a little darker than the ground color; disk variegated by more grayish subhyaline areas on the posterior half of wing, the radial field more uniformly pale brown; veins pale brown, a little lighter in the costal and prearcular fields. Costal fringe moderately long, at base with setæ very sparse and tiny; anterior branch of Rs without trichia; R_5 and all outer branches of M with numerous trichia. Venation: Sc short, Sc_1 ending some distance before origin of Rs, the distance on C equal to about two-thirds the length of Rs; Rs only a little shorter than its anterior branch, the latter directed strongly cephalad, so cell R_4 at margin is very wide; m-cu close to fork of M.

Abdominal tergites dark brown, the incisures restrictedly paler; sternites and hypopygium more yellowish. Male hypopygium (Plate 2, fig. 31) with two dististyles, both terminal in position. Outer style, *od*, a simple sinuous rod, the base with a small mesal flange, the central third of the blade a little wider, the apex obtuse. Inner style, *id*, bearing two, long, slender, pale arms, each tipped with a small blackened spine; outer rod a little longer than the inner, the latter bearing two spines on one side and only one on the other (of the unique type, probably abnormal, and the condition may be normally unispinous). Phallosome, *p*, appearing as two divergent, flattened, black horns that run out into smooth black spines, the surface microscopically serrulate and provided with appressed spinulose points.

Habitat.—Assam (Khasi Hills).

Holotype, male, Cherrapunji, altitude 4,000 feet, August, 1935, at light (*Sircar*).

I take great pleasure in naming this distinct crane fly in honor of the collector of this interesting series of Tipulidæ from the Khasi Hills, Mr. S. Sircar. The species is readily distinguished from other, generally similar, allied species in this faunal area, such as *flavomarginata* Brunetti and *nissoriana* sp. nov., by the structure of the male hypopygium.

GONOMYIA (LIPOPHLEPS) NISSORIANA sp. nov. Plate 1, fig. 21; Plate 2, fig. 32.

General coloration dark brown; scutellum obscure yellow, darkened medially at base; pleura with a clear yellow longitudinal stripe; knobs of the halteres darkened; legs brownish black; wings with a faint brown tinge, the costal border whitened; stigma and narrow seams along cord and outer end of cell 1st M_2 vaguely seamed with pale brown; Sc short; abdominal tergites uniformly dark brown, the sternites and hypopygium yellow; male hypopygium with both dististyles terminal in position, the inner at apex produced into a long yellow arm that is tipped with a small black spine and bears a single very long bristle that is longer than the arm itself.

Male.—Length, about 2.7 millimeters; wing, 3.

Rostrum and palpi black. Antennæ with the scape black, pedicel chiefly orange, flagellum black. Head light yellow, the central portion of vertex weakly darkened.

Pronotum and the lateral pretergites light yellow. Mesonotal præscutum and scutum dark brown, the surface sparsely pruinose; pseudosutural foveæ reddish brown; scutellum obscure yellow, the base darkened; mediotergite extensively obscure yellow, darkened behind and on sides. Pleura with dorsal sclerites and membrane brownish yellow; a broad, clear yellow, longitudinal stripe extending from the fore coxæ to the base of abdomen, passing beneath the halteres, narrowly bordered above by darker brown; ventral sternopleurite darkened. Halteres with the stem dusky, the knob yellow. Legs with the coxæ testaceous, the fore pair somewhat clearer; remainder of legs brownish black; posterior femora with moderately erect setæ along the entire length. Wings (Plate 1, fig. 21) with a faint brown tinge, the prearcular and costal portions more whitened; stigma long-oval, slightly darker brown than the ground; cord and outer end of cell 1st M_2 vaguely seamed with pale brown, best indicated by a darkening of the veins; veins brown, more yellowish in the whitened areas. Anterior branch of Rs without trichia; R_5 and all outer branches of M with numerous trichia. Venation: Sc short, Sc_1 ending some distance before origin of Rs, the distance on C about one-half Rs; anterior

branch of Rs directed rather strongly cephalad so cell R_2 at margin is only a little more than one-third as extensive as cell R_4; m-cu at fork of M.

Abdominal tergites uniformly dark brown; sternites and hypopygium yellow. Male hypopygium (Plate 2, fig. 32) with the two dististyles terminal in position, the outer style, *od,* a glabrous darkened blade, shaped more or less like a cleaver, the margins smooth. Inner dististyle, *id,* at apex extended into a long, slender, yellow arm that is tipped with a small black spine and a single very long seta that is longer than the arm itself; the arm at near midlength bears a dense group of short setæ. Phallosome, *p,* consisting of coiled yellow rods that terminate in a dense brush of setæ.

Habitat.—Assam (Khasi Hills).

Holotype, male, Cherrapunji, altitude 4,000 feet, August, 1935, at light (*Sircar*).

I take much pleasure in naming this distinct species in honor of Mr. Nissor Singh, veteran collector of the Himalayan Butterfly Company, who celebrated his eightieth birthday in December, 1935. The fly is allied to species such as *Gonomyia* (*Lipophleps*) *sircari* sp. nov., and *G.* (*L.*) *luteimarginata* Alexander, differing very conspicuously from all described forms in the structure of the male hypopygium.

CRYPTOLABIS (BÆOURA) DICLADURA sp. nov. Plate 1, fig. 22; Plate 2, fig. 33.

General coloration dark gray, the scutellum yellow, darker medially at base; legs with short setæ; wings with a slight grayish tinge, the stigmal region weakly suffused; prearcular and costal regions more whitened; cell 2d A wide, vein 2d A deflected caudad on its distal third; male hypopygium with the dististyles subterminal in position, profoundly bifid, the inner arm longer than the outer.

Male.—Length, about 3.5 millimeters; wing, 3.8.

Female.—Length, about 3.6 millimeters; wing, 4.

Rostrum dull black; palpi infuscated. Antennæ dark throughout; pedicel black; outer flagellar segments elongate. Head uniformly gray.

Pronotum yellowish white. Mesonotal præscutum and scutum almost uniformly dark gray, or blackish with a relatively sparse pruinosity; scutellum yellow, darker medially at base; postnotum gray. Pleura dark brownish gray, the dorsopleural region yellow. Halteres pale, the knobs darkened. Legs with the coxæ and trochanters testaceous-brown; femora obscure yellow, the tips infuscated; tibiæ and tarsi brownish black; vestiture of legs

short and appressed, inconspicuous. Wings (Plate 1, fig. 22) with a slight grayish tinge, the stigmal region weakly suffused; a vague darkened seam along cord, best indicated by a more intense coloring of the veins traversed; prearcular and costal regions more whitened; veins brown, pale in the whitened areas. Costal fringe relatively long and conspicuous. Venation: R_2 a little shorter than R_{2+3}; m-cu at near midlength of M_{3+4}; cell 2d A wide, the vein deflected caudad on its distal third.

Abdomen dark brown, the hypopygium brightened. Male hypopygium (Plate 2, fig. 33) with the ninth tergite, *9t*, having each outer lateral angle produced into a slender straight point; median area of tergite slightly produced, the caudal border gently concave. Dististyle, *d*, subterminal in position, long and slender, profoundly bifid, the outer arm only about one-half as long as the inner but somewhat stouter. Ædeagus, *a*, terminating in a very long needlelike point.

Habitat.—China (Hainan Island).

Holotype, male, Ta Hian, altitude 2,000 feet, June 11, 1935 (*Gressitt*). Allotopotype, female. Paratopotype, 1 female.

Compared with other similar regional species of *Bæoura* that have the wings broad, cell 2d A wide, inconspicuously hairy legs, and conspicuously brightened scutellum, the present fly is readily told by the somewhat remarkable male hypopygium, especially the dististyle.

CRYPTOLABIS (BÆOURA) SETOSIPES sp. nov. Plate 1, fig. 23; Plate 2, fig. 34.

Belongs to the *trichopoda* group; general coloration black; scutellum obscure yellow; wings with a dusky tinge, the costal border more whitened; a broad dark seam along cord; cell 2d A narrow; male hypopygium with the lateral angles of the tergite extended caudad into narrow arms; dististyle deeply bilobed, the inner arm slender.

Male.—Length, about 3.3 millimeters; wing, 4.

Female.—Length, about 3.5 millimeters; wing, 4.

Rostrum testaceous; palpi brown. Antennæ apparently 14-segmented, short, dark brown; flagellar segments passing through short-cylindric into long-cylindric; terminal segment longer than the penultimate, constricted at near midlength; verticils very long and conspicuous. Head light gray; setæ and punctures conspicuous.

Pronotum testaceous-gray. Mesonotal præscutum dull black, the humeral region scarcely brightened; scutum, including median area, dull black; scutellum obscure yellow, darker medially at base, parascutella black; mediotergite dark, heavily gray

pruinose. Pleura black, heavily pruinose; dorsopleural membrane paler. Halteres dusky, the base of stem restrictedly brightened, the knobs a little paler. Legs with the fore coxæ black, the middle and hind coxæ a little paler; trochanters testaceous-yellow; femora brown; tibiæ and tarsi brownish black; segments with very long erect setæ, as in the group; claws (male) very long and slender, each with a long, pale, erect seta or setoid spine at base. Wings (Plate 1, fig. 23) with a dusky tinge, the entire costal border both before and beyond the stigma whitened; stigma and a broad confluent seam along the cord darker than the ground; basal portions of wing a trifle infumed; veins dark, paler in the whitened costal portions. Venation: Sc_1 ending opposite cord, Sc_2 not far from its tip; cell 2d A narrow.

Abdomen, including hypopygium, brownish black. Male hypopygium (Plate 2, fig. 34) with the tergite, *9t*, produced laterad and caudad into slender glabrous points; median portion of caudal border likewise produced into a low triangular point. What seems to be a part of the eighth sternite is represented by a slender pale structure that terminates in two strong modified setæ, suggesting the condition found in *Styringomyia.* Dististyle, *d*, terminal, deeply bifid, the broader outer arm with numerous setigerous punctures, including a dense group at apex; before tip, near inner margin of lobe, with two slender spines; inner arm nearly as long but much slenderer, with setæ only at apex. Ædeagus, *a*, broadly depressed, except on apical portion.

Habitat.—China (Hainan Island).

Holotype, male, Ta Hian, altitude 2,000 feet, June 11, 1935 (*Gressitt*). Allotype, female, Liamui, altitude about 1,200 feet, July 31, 1935 (*Gressitt*). Paratopotype, female.

In its hypopygial structure, *Cryptolabis* (*Bæoura*) *setosipes* is very different from the other members of the *trichopoda* group described to this date.

CRYPTOLABIS (BÆOURA) CONSONA sp. nov. Plate 2, fig. 35.

Belongs to the *trichopoda* group, closely allied to *setosipes;* male hypopygium with the outer lateral angles of tergite produced caudad into very long, slender blades, the tips subacute; dististyle simple, appearing as an elongate blade, narrowed outwardly to the obtuse tip, on outer face at near two-thirds the length with a small peglike spine.

Male.—Length, about 3.3 millimeters; wing, 4.

Female.—Length, about 3.5 millimeters; wing, 4.

Rostrum and palpi dark. Antennæ of moderate length, dark throughout, apparently 15-segmented; basal flagellar segments

short-oval, the outer segments more elongate, with very long, conspicuous verticils. Head gray.

Mesonotum dull black, the surface very sparsely pruinose; scutellum obscure brownish yellow, the base darkened medially; postnotum more heavily pruinose. Halteres weakly suffused with dusky, especially the central portion of stem. Legs with the coxæ brownish testaceous; trochanters obscure yellow; femora brown; tibiæ obscure yellow, the tip narrowly darkened, especially the distal portions of posterior legs; tarsi brown, passing into black outwardly; segments of legs with very long conspicuous setæ, as in the group. Wings with a strong dusky tinge, the costal region more whitish; a darkened cloud along cord; basal cells slightly infumed, leaving rather clearer areas before and beyond the cord; stigma a little darker; veins dark, somewhat paler in the costal field. Venation: Virtually identical with that of *setosipes;* cell 2d A a trifle narrower.

Abdomen, including hypopygium, brownish black. Male hypopygium (Plate 2, fig. 35) with the outer lateral angles of tergite, *9t*, produced caudad into very long, slender blades, the tips subacute; caudal margin between the horns transverse or very slightly protuberant, not produced into a point as in *setosipes.* Dististyle, *d*, simple, appearing as an elongate blade that narrows outwardly, the tip obtuse; outer face of style at near two-thirds the length with a small peglike spine; before apex of style, near inner margin, with two or three small spinous points, as in *setosipes.*

Habitat.—China (Hainan Island).

Holotype, male, Dwa Bi, altitude about 1,500 feet, July 21, 1935 (*Gressitt*). Allotopotype, female.

Cryptolabis (*Bæoura*) *consona* is very similar in its general appearance to *C.* (*B.*) *setosipes* sp. nov., but is entirely distinct in the structure of the male hypopygium.

STYRINGOMYIA HOLOMELANIA sp. nov. Plate 1, fig. 24; Plate 2, fig. 36.

Entire body black; halteres and legs black, the tarsal segments slightly paler on basal portions; wings narrow, whitish subhyaline, the cord and vein Cu seamed with brown; anterior branch of Rs oblique; male hypopygium with the basistyle bearing two spines, the inner one only half the length of the outer; outer lobe of dististyle with a dense group of spines near base; tenth tergite with median lobe very slender; ninth sternite bilobed at apex.

Male.—Length, about 5 millimeters; wing, 3.4.

Rostrum and palpi black. Antennæ black, the outer flagellar segments a trifle paler. Head black.

Thorax entirely black, including the coarse but unmodified setæ. Halteres black. Legs black, the basal three tarsal segments a very little paler on their proximal portions. Wings (Plate 1, fig. 24) narrow, whitish subhyaline, the cord and vein Cu seamed with brown; veins brown. No macrotrichia on veins behind R_1 excepting a complete series of about twenty-two on vein R_5 and an isolated bristle on anterior branch of Rs; two or three trichia on outer ends of distal sections of medial veins. Venation: Anterior branch of Rs oblique; cell 1st M_2 long and narrow, exceeding any of the veins beyond it; m-cu sinuous, at near one-third the length of cell 1st M_2; vein 2d A unspurred but strongly curved near outer end.

Abdomen black throughout. Male hypopygium (Plate 2, fig. 36) with the basistyle, *b*, bearing two unequal spines on a short apical lobe, the outer spine about twice the length of the inner, flattened on basal half; inner spine obtuse at apex. Tip of basistyle with an acute blackened spine that is directed mesad. Outer lobe, *od*, of dististyle relatively stout, bearing a dense group or comb of equal black spines on mesal face near base; inner lobe, *id*, produced into two arms. Tenth tergite, *t*, with the median lobe very slender, appearing as a ligulate structure clothed with abundant erect setæ. Ninth sternite, *9s*, bilobed at apex, each lobe obtusely rounded, the median notch acute; the two usual modified setæ placed basally on lobes, unusually slender and more or less decussate.

Habitat.—Assam (Khasi Hills).

Holotype, male, Cherrapunji, altitude 4,000 feet, August, 1935, at light (*Sircar*).

Styringomyia holomelania is very different from all described species that have bispinous basistyles on the male hypopygium. The uniformly black coloration of the body, halteres, femora, and tibiæ provide characters that separate the fly from all species of the genus hitherto described. It seems to be most nearly allied to *S. obscura* Brunetti, yet is amply distinct in the coloration of the body, wings, and legs.

ILLUSTRATIONS

[*a*, Ædeagus; *b*, basistyle; *d*, dististyle; *dd*, dorsal dististyle; *id*, inner dististyle; *od*, outer dististyle; *p*, phallosome; *s*, sternite; *t*, tergite; *vd*, ventral dististyle.]

PLATE 1

FIG. 1. *Longurio hainanensis* sp. nov., venation.
2. *Nephrotoma hainanica* sp. nov., venation.
3. *Phalacrocera tarsalba* sp. nov., venation.
4. *Limonia (Gressittomyia) xenoptera* sp. nov., venation.
5. *Limonia (Limonia) calcarifera* sp. nov., venation.
6. *Limonia (Libnotes) quinque-costata* sp. nov., venation.
7. *Antocha (Antocha) flavidula* sp. nov., venation.
8. *Antocha (Antocha) khasiensis* sp. nov., venation.
9. *Pseudolimnophila concussa* sp. nov., venation.
10. *Pseudolimnophila seticostata* sp. nov., venation.
11. *Hexatoma (Euhexatoma) triphragma* sp. nov., venation.
12. *Hexatoma (Eriocera) tuberculata* sp. nov., venation.
13. *Hexatoma (Eriocera) hirtithorax* sp. nov., venation.
14. *Elephantomyia (Elephantomyodes) angusticellula* sp. nov., venation.
15. *Trentepohlia (Mongoma) hainanica* sp. nov., venation.
16. *Gonomyia (Ptilostena) hainanensis* sp. nov., venation.
17. *Gonomyia (Lipophleps) conquisita* sp. nov., venation.
18. *Gonomyia (Lipophleps) pallicostata* sp. nov., venation.
19. *Gonomyia (Lipophleps) pulvinifera* sp. nov., venation.
20. *Gonomyia (Lipophleps) sircari* sp. nov., venation.
21. *Gonomyia (Lipophleps) nissoriana* sp. nov., venation.
22. *Cryptolabis (Bæoura) dicladura* sp. nov., venation.
23. *Cryptolabis (Bæoura) setosipes* sp. nov., venation.
24. *Styringomyia holomelania* sp. nov., venation.

PLATE 2

FIG. 25. *Limonia (Gressittomyia) xenoptera* sp. nov., male hypopygium.
26. *Antocha (Antocha) flavidula* sp. nov., male hypopygium.
27. *Antocha (Antocha) khasiensis* sp. nov., male hypopygium.
28. *Pseudolimnophila concussa* sp. nov., male hypopygium.
29. *Gonomyia (Lipophleps) pallicostata* sp. nov., male hypopygium.
30. *Gonomyia (Lipophleps) pulvinifera* sp. nov., male hypopygium.
31. *Gonomyia (Lipophleps) sircari* sp. nov., male hypopygium.
32. *Gonomyia (Lipophleps) nissoriana* sp. nov., male hypopygium.
33. *Cryptolabis (Bæoura) dicladura* sp. nov., male hypopygium.
34. *Cryptolabis (Bæoura) setosipes* sp. nov., male hypopygium.
35. *Cryptolabis (Bæoura) consona* sp. nov., male hypopygium.
36. *Styringomyia holomelania* sp. nov., male hypopygium.

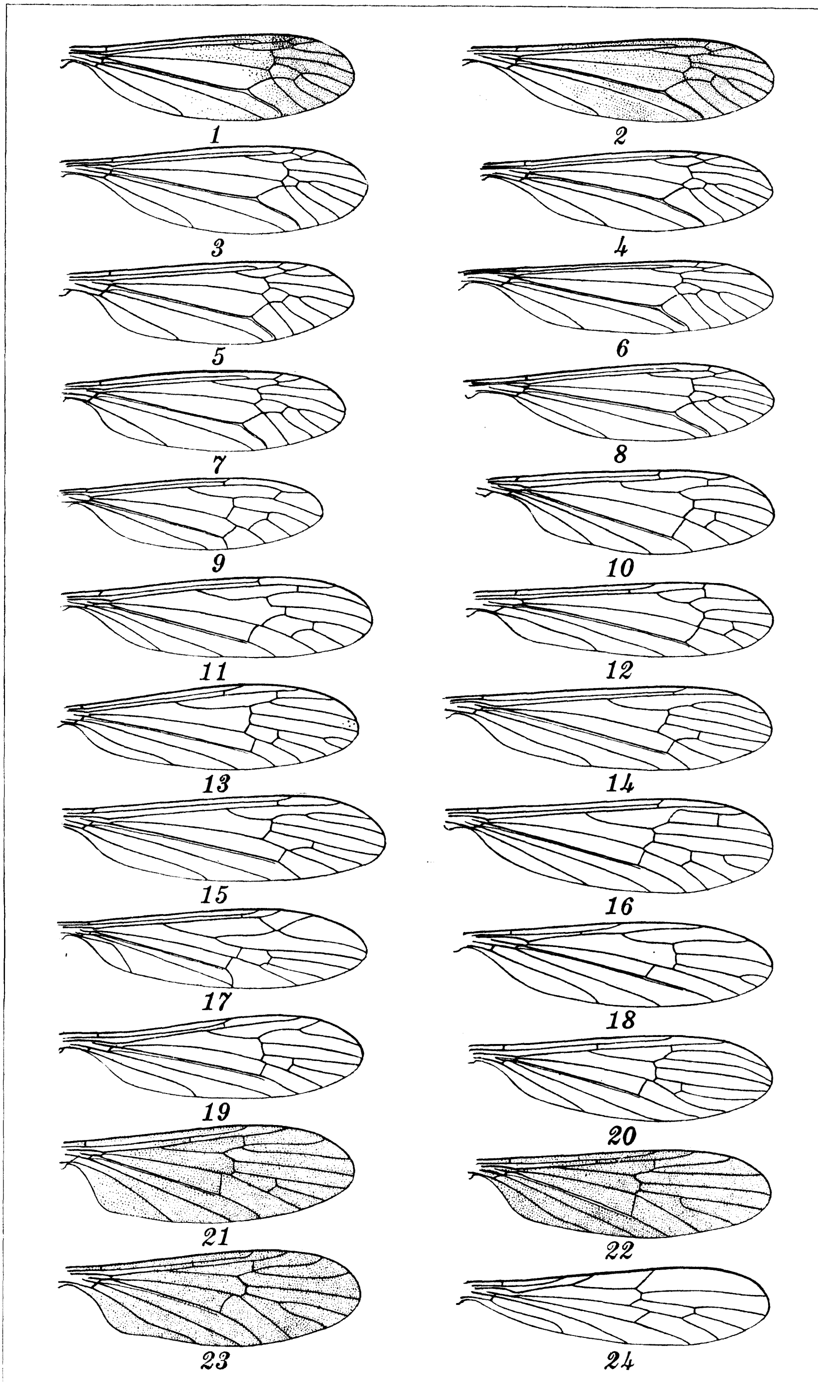


PLATE 1.

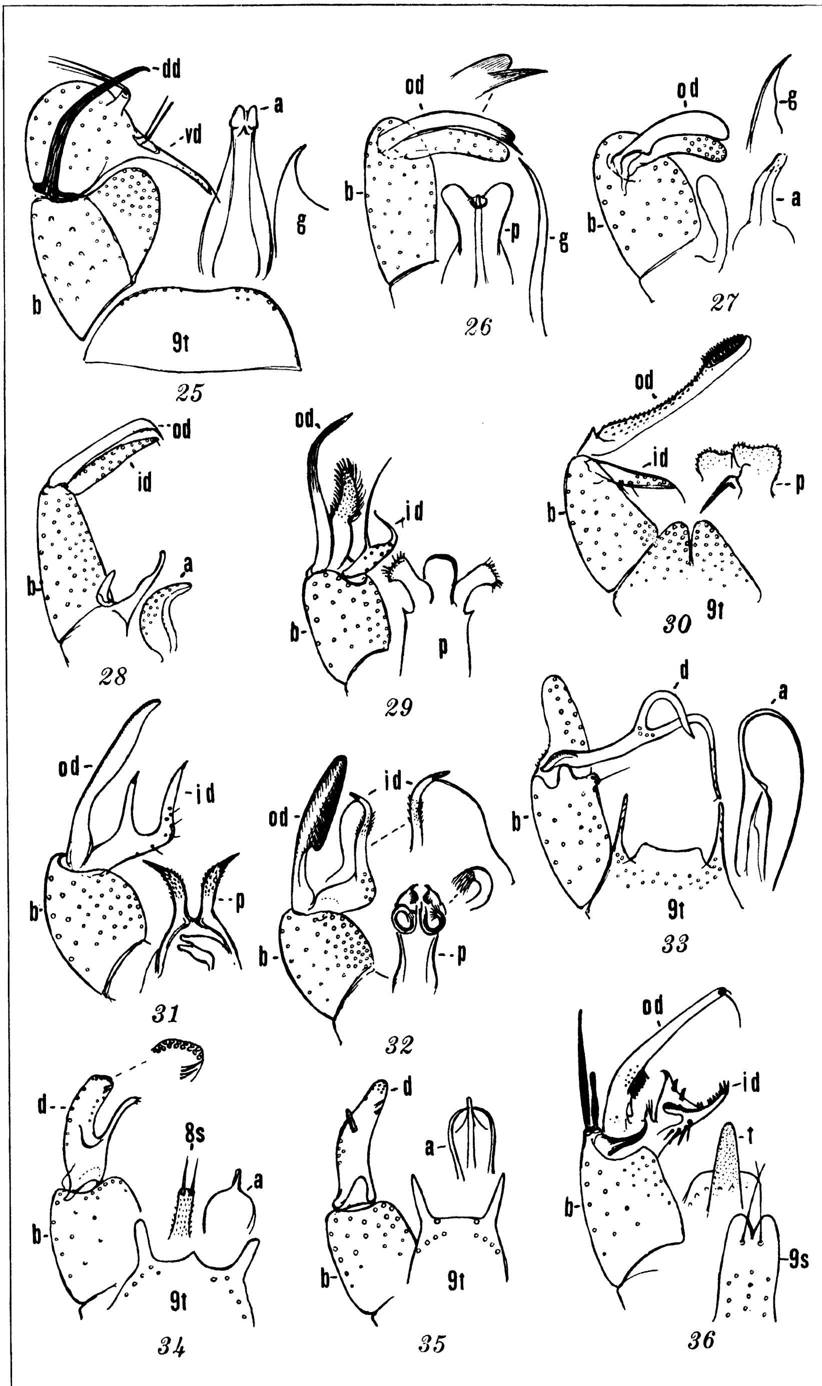

dd
vd
a
g
b
9t
25
od
b
p
g
26
od
g
a
b
27
od
id
b
a
28
od
id
b
p
29
od
id
p
b
9t
30
od
id
b
p
31
id
od
b
p
32
d
a
b
9t
33
d
8s
a
b
9t
34
d
a
b
9t
35
od
id
t
b
9s
36

PLATE 2.

BOOKS

Acknowledgment of all books received by the Philippine Journal of Science will be made in this column, from which a selection will be made for review.

RECEIVED

JULY 1, 1936

BUSCHKE, ABRAHAM, and F. JACOBSOHN. Sex habits; a vital factor in well-being. Tr. from the German by Eden and Cedar Paul. N. Y., Emerson books, 1933. xiii + 190 pp., illus. Price, $2.50.

DUKES, H. H. The physiology of domestic animals. 3d rev. ed. Ithaca, N. Y., Comstock publishing co., 1935. xiv + 643 pp., illus., tables, diagrs. Price, $6.

HARROWER, H. R. Three lectures on endocrinology in everyday practice. Glendale, California, The Harrower laboratory. [c. 1936.] 62 pp. Price, $1.

HARVEY, WM. CLUNIE, and HARRY HILL. Milk production and control, by Wm. Clunie Harvey and Harry Hill. London, H. K. Lewis & co., 1936. 555 pp., illus. Price, $10.50.

HODSON, Mrs. CORA B. S. Human sterilization to-day; a survey of the present position. London, Watts & co., 1934. vii + 55 pp. Priee, $0.25.

International institute of agriculture. Rome. The world agricultural situation in 1933–34. (World agriculture; conditions and trends; markets and prices. Agricultural policies and conditions in the different countries.) Economic commentary on the International year-book of agricultural statistics for 1933–34. Rome, 1935. viii + 502 pp., tables. Price, $2.50.

JEFFREYS, HAROLD. Earthquakes and mountains. London, Methuen & co., 1935. x + 183 pp., front., plates, diagrs. Price, $2.

JOHN, H. J. Diabetic manual for patients. 2d ed. St. Louis, Missouri, The C. V. Mosby co., 1934. 232 pp., front., illus., tables, diagrs. Price, $2.

LORD, F. T. Lobar pneumonia and serum therapy; with special reference to the Massachusetts pneumonia study [by] Frederick T. Lord and Roderick Heffron. N. Y., The Commonwealth fund, 1936. 91 pp., illus., plate, diagrs. Price, $1.

RITSHER, W. H. Criteria of capacity for independence. Jerusalem, Syrian orphanage press, 1934. ix + 152 pp. Price, $2.

REVIEWS

The Bacteriological Grading of Milk. By G. S. Wilson. Medical Research Council, Special Report Series, No. 206. His Majesty's Stationary Office, London, 1935. 392 pp. Price, $2.

This book gives the results of the author's critical studies on the various technical procedures that have been heretofore used

in the examination of milk. The usefulness of these procedures is discussed extensively with recommendations on the methods that should be followed.

A description of the modified methylene blue reduction test is given, and, according to the author, the test seems to fulfill most of the requirements demanded of the routine grading of raw milk. It gives more information about the milk than does the plate count, the performance of which requires an elaborate procedure by highly skilled workers. According to him the plate count seems to afford no better index of the sanitary conditions of production or of the keeping quality of the milk than the Breed test or the modified methylene blue test. The latter test could be advantageously applied even to certified milk.

Whether the test is suitable for the examination of freshly pasteurized milk or not is doubtful, but there is reason to believe that it could well replace the plate count on bottle samples delivered to the consumer.

Finally, it is recommended that whatever test is used no attempt should be made to divide milk into more than three or four classes. From the public-health point of view probably only two divisions need be made on the basis of cleanliness; namely, (*a*) milk that is suitable and (*b*) milk that is not suitable for human consumption in the liquid state.—T. R. R.

The World Economic Survey, 1934–35. Fourth Year. Economic Intelligence Service, League of Nations, Geneva, Switzerland, 1935. 310 pp. Price, $2.

The book is an extensive review of the world economic and financial developments up to July, 1935, being the fourth of an annual series published by the League of Nations. The significant events featured in the international economic commotion during the last few years being presented in a comprehensive and coherent manner, this survey surely is indispensable to anyone who desires to gain a full grasp of the world economic situation. Considerable emphasis is laid on the subjects of currency, production, overseas trade, unemployment, and industrial recovery. Statistical tables, indices, and graphs are widely distributed from cover to cover, with the corresponding explanations so given as to be intelligible to the lay reader.

The opening chapter presents a kaleidoscopic view of the chaotic state of economic affairs the world over in 1934. Various steps undergone by the government towards the solution of the problems in finance and trade are mentioned as each country is surveyed. The movement of agricultural and industrial

prices is graphically dramatized by charts and tables. Statistical data of different countries illustrate impressively the law of supply and demand as it affects production, prices, and consumption. With the dawn of industrial recovery is treated the question of unemployment and stability of wages. The rôle played by the National Recovery Act, of all movements, is mentioned in this connection. The recent adjustments in international trade and equilibrium and the expanding basis of credit are equally dealt with comprehensively. The last chapter reviews the more recent constantly changing scenes in the world economic "movies," prominent among them being the "New Deal" program which has become linked with the Roosevelt administration.

The work is well indexed, and on the last pages is appended a chronological list of important world economic events from August, 1934, to July, 1935.—L. M. G.

Milk Production and Control. By W. C. Harvey and Harry Hill. H. K. Lewis & Co. Ltd., London, 1936. 555 pp., illus. Price, $10.50.

This book is a welcome addition to dairy literature. As the title indicates, special attention is given to the different phases of production and control of milk. Although the book was specially written for present conditions in England, much can be learned from its chapters to help those directly connected with the production and distribution of milk and its supervision in any country.

The first chapter deals with the composition of milk and its food value and rightly serves as an introduction to the entire subject herein treated. The second chapter, Milk and Disease, discusses briefly the various diseases transmitted to man in milk. The authors mention several outbreaks to emphasize the importance of milk in its relation to human health. The chapters on the cow and the cow shed discuss briefly the proper care and housing of milk cows. Dairy equipment, actual milk production, and proper distribution are also discussed, with appropriate illustrations, in separate chapters.

A long chapter is devoted to the treatment of milk by heat. Here the different processes of pasteurization of milk and the problems connected with each process are discussed. Stassanization, sterilization, and irradiation of milk are also mentioned in this chapter. Another long chapter, devoted to laboratory and other control, is a good guide for students, health inspectors, and laboratory technicians connected with the inspection of milk.

In the chapters on designated milk and legislative control, the reader can easily follow the development of the dairy industry in England.

Milk Production and Control is not only a good guide or reference book for people concerned with the production and distribution of milk and government officials connected with milk inspection, for whom the authors have written this work, but will also serve as a suitable textbook for classrooms.—S. Y. R.

Diabetic Manual for Patients. By H. J. John. Second Edition. The C. V. Mosby Company, St. Louis, 1934. 232 pp. Price, $2.

In this little book the author tries "to present clearly and briefly what the person with diabetes should know about the disease and its treatment in order that he may more fully and therefore more successfully coöperate with his physician." With this purpose in view the author explains the underlying laws and principles, the conscious or unconscious violation of which in some way or other produces the disease. He describes how it is acquired and the changes that take place in the body during the illness.

Since food plays an important rôle in the medical improvement of the patient, a good portion of this book is devoted to diet planned according to the modern trend of giving food more rich in carbohydrates. Thus the food values of different food products are given, the appendices being fully devoted to this purpose. The author also stresses the efficacy and necessity of insulin treatment, and unlike many physicians, encourages its use.

—I. F.

Who Shall Survive; a New Approach to the Problem of Human Interrelations. By J. L. Moreno. Washington, D. C., Nervous and Mental Disease Publishing Co., 1934. 437 pp., diagrs. Price, $4.

Who Shall Survive deals with the study of the emotional relations among individuals who are functioning as a social group, or the cross-currents of emotion as they play back and forth between individuals. The material and illustrations are drawn from institutions and schools. The author develops a technic for a process of classification calculated to bring individuals together who are capable of harmonious interpersonal relationships, and creates a social group which can function at the maximum efficiency and with the minimum of disruptive tendencies and processes. He has rediscovered many homely truths by a different method which permits of their development to a more highly differentiated degree and also their utilization for the benefit of the individual. He differs from the psychoanalytic

approach in a significant way. While the analyst works backward to an explanation for the individual's conduct, he takes the individual's conduct as the starting point and works forward. All his various points of view, methods, and technic are of great significance. This is a good reference book on social problems. —R. E. G.

The Student's Manual of Microscopic Technique; with Instructions for Photomicrography. By J. C. Tobias. American Photographic Publishing Co., Boston, Mass., 1936. 210 pp., illus. Price, $2.50.

This is a useful guide for students of anatomy and biology. It contains (*a*) a good chapter on the microscope, its care, uses, and the physical rationale of its operation, including the polarizing microscope; (*b*) another excellent chapter on the microscopic objects found in water and the modes of their examination; (*c*) several chapters on the commoner methods of preparing tissues for microscopic examination, including the principal procedures of sectioning, staining, etc., and their examinations microscopically in the fresh state and as permanent preparations; and (*d*) a special section on microphotography. Most of the principal topics are illustrated with excellent text figures.

The author has happily combined in one compact and convenient volume the principal methods of microscopic technic usually found in such standard works as Gage's, Lee's, Mallory and Wright's, and others. The book should have general acceptance as an excellent complement to ordinary textbooks of histology and pathology.—A. G.

Mountains and Earthquakes. By Harold Jeffreys. Methuen & Co. Ltd., London, 1935. 183 pp. Price, $2.

This book gives a comprehensive discussion of the latest developments in the study of the earth from the view points of the physicist, the geologist, and the geodesist. The presentation is well planned, and the language, though precise, is simple. The subject is probably too far advanced for the comprehension of the layman, but it is very interesting to the technical man who has a good working knowledge of mathematics, physics, and geology.—Q. A. A.

The Mental Health Emphasis in Education—A Qualitative Study. By H. C. Patey and G. S. Stevenson. The National Committee for Mental Hygiene, Inc., New York. 96 pp.

This treatise has for its working principle the idea that "basically the philosophy of mental hygiene and education are identical and may be stated in terms of complete living or satisfac-

tory functioning of the human organism." In terms of this principle it asserts that "at the present time the relationships of mental hygiene and education are confused by the fact that mental hygienists have given much of their attention to corrective therapy while educationalists have been concerned with fostering normal development without insight gained from observations of exaggerated functioning," and makes an effort to indicate methods of coördinating, articulating, and integrating the other agencies of society; namely, industry, business, law, social service, journalism, art, theology, and medicine, with education, in order for the latter "to realize all of the opportunities that lie within the scope of its own organization and objective." Perhaps too confident and optimistic, the authors claim that "the professional mental hygienist brings to each situation and interpretation intensive experience with the problems of individuals, with the purpose of bringing objectives to a focus in terms of what is most satisfying."—A. V. C.

Elementary Microtechnique. By H. Alan Peacock. Edward Arnold & Co., London, 1935. 200 pp. Price, $1.50.

This is an unassuming little book, which contains much useful information on microtechnic. It is intended primarily for beginners in histology and cytology, although advanced students equally will find the work a good reference book.

The book is introduced with a short summary of the structure of the cell and protoplasm, followed by brief descriptions of the processes of microtechnic. Chapters III and IV cover outlining methods and technic. There is an alphabetical list of special subjects with the various methods to be followed and their preparation in Chapter V; of stains and their uses in Chapter VI; and of formulæ and hints in Chapter VII. Three appendices are included, the last being a bibliography.—M. T.

Sex Practice in Marriage. By C. B. S. Evans. Second Edition. Emerson Books, Inc., New York, 1935. 128 pp. Price, $1.95.

This is a clear and simple exposition of a subject of vital interest to married couples and young people contemplating marriage who are seeking happiness. The book, which is so easy to read that it will but take few hours to finish, will not only help bring about a better understanding between husband and wife but also make for a better appreciation of each other's needs and problems. In serving as a guide in securing a happy mating, this book will help married people in solving their marital problems arising from ignorance of the proper functions

of sex, which will be conducive to harmony in the home, lessen friction, and minimize divorce. Likewise physicians will find the book a great help to their own method of handling related problems.—U. D. M.

Engineer-Custodians Manual. By Thomas J. Brett. American Technical Society, Chicago, 1934. 192 pp. $2.50.

This is a useful book for building superintendents, engineers, custodians, firemen, electricians, and others interested in the operation and maintenance of public buildings. It embodies valuable information that is usually required for passing competitive civil-service examinations; contains over 500 questions and answers on boilers, combustion engines, heating and ventilating, air-conditioning, pumps, sanitation, plumbing, electrical machinery, and mechanics; over 200 engineering formulas and tables, and general information. The book is fully indexed.

—R. M.

Diesel and other Internal-Combustion Engines. By Howard E. Degler. American Technical Society, Chicago, 1936. 237 pp. Price, $2.50.

This is practical text on the development, principles of operation, construction, details, and performance of stationary and portable diesel, gas, and gasoline engines.

In Part I the development and application, types, characteristics, efficiency, advantages, thermodynamics, and comparison of internal-combustion engines are set forth. Part II classifies fuels and fuel-air mixtures, gas producers, and liquid fuels and gives fuel-burning characteristics. Part III contains valuable information on automobile and aëroplane gas and gasoline engines. Part IV treats of low-pressure and moderate-pressure oil engines. Part V is devoted to heavy-duty diesel engines of various types. Part VI takes up high-speed diesel engines, their development and application. In Parts VII, VIII, IX, and X is found valuable information on diesel fuel-injection requirements and methods, engine parts, testing and testing methods, and economics of diesel power, respectively.—R. M.

Carpentry. By Gilbert Townsend. American Technical Society, Chicago, 1936. 436 pp. Price, $2.

This book is a practical treatise on simple building construction, including framing, roof construction, general carpentry work, exterior and interior finish of buildings, building forms, and working drawings.

The book is adapted for use as a text in vocational, trade, high, and technical schools. It is an excellent text for home

study and reference for carpenters, apprentices, home owners, and anyone interested in building construction work.—R. M.

Air Conditioning and Engineering. By Engineering Staff of American Blower Corporation and Canadian Sirocco Co., Ltd. American Blower Corporation, Detroit, 1935. 691 pp. Price, $5.

This is a treatise on the technic of conditioning and mechanical movement of air for the health and comfort of human beings and the efficiency of production in industry. It is a ready reference containing valuable data on air conditioning and engineering, including fundamental principles, laws, tables, sample calculations, and information relating to dimensions and capacities. In the apparatus and equipment section are found dimension and capacity tables and types of equipment used in actual practice. It is an excellent book for air-conditioning engineers.
—R. M.

A Guide to Sexing Chicks. By Charles S. Gibbs. Orange Judd Publishing Co., Inc., New York, 1935. 63 pp. Price, $1.25.

The author is a research professor of veterinary science at the Massachusetts State College at Amherst. In his Guide to Sexing Chicks he describes the art which was first brought to light by Kiyoshi Masui and Juro Hashimoto of Tokyo Imperial University, and later put into practical application by Kojima and Sakagiyma. He mentions two schools of chick sexing, one depending upon the presence or absence of processes in the vent, and the other on the wrinkles of the mucuous membrane of the cloaca.

Sexing chicks, as an art, requires skill, clear vision, rapid eye accommodation and ability to withstand bright light, steady hands, and nimble fingers. To the novice patient practice and mastery of its technic are necessary to attain a satisfactory degree of proficiency. The detailed description of the steps to be undertaken given in this book will be of practical value to him and other beginners.

The author suggests that sexing be done in bright day light or with the use of a 200-watt electric bulb, either blue or with frosted tip. The best time to sex is twelve hours after hatching or as soon as the chick has dried. A large process in the vent identifies a cockerel, and no process or a small one, a female. In actual identification a group of 5 per cent is confusing and may turn out one way or the other.—C. X. B.

The Medical Cookery Book. By Dorothy Sewart. J. Wright and Sons, Ltd., London, 1935. 136 pp. Price, $1.25.

In the convalescent stage of many diseases in which drugs usually play an insignificant part, nourishment is more vitally important to the patient, since a suitable diet is more conducive to recovery. At this stage the consideration of proper foods becomes the concern of those whose responsibility it is to prescribe diet. The 300 recipes compiled in this book for making soup, salads, and other ideal foods for convalescents will provide the solutions to most of the problems concerning the right foods to give. The recipes have been thoroughly tested and are simple and economical. The book also contains much information on how the foods should be served, which suggestions increase its practical value.—A. J. H.

International Trade; Principles and Practices. By Paul V. Horn. Prentice-Hall, Inc., New York, 1935. 723 pp. Price, $5.

A comprehensive treatise on its subject, this book not only deals with the principles and practices of foreign trade, but also treats of its historical background and its legal aspects. Intended primarily as a textbook for use in colleges and universities, the book will be found useful by students and by those who are actually engaged in international trade. A lot of valuable information is given which the latter, especially, could use to advantage to broaden their knowledge of the aspects of oversea trade as a profession. The subject is discussed as a business calling, and also as an instrument of governments in their international relations with one another.

Chapters 5 and 6 deal with a graphical survey of international trade. Chapters 10 and 11 give a history of tariffs in general and of United States tariff in particular, and trace the evolution of international commercial policies from antiquity to the present. Thoroughly discussed in Chapters 17 and 18 are the subjects of foreign investments, foreign exchange, and the financing of foreign trade. The practical modus operandi of foreign business trade is likewise fully treated, just as the technic of foreign-trade promotion and advertising and the collection of foreign credits are ably presented.

Adding much to the usefulness of the book are the review questions, problems, and suggested references at the end of each chapter.

A typographical error in the chart on page 154 (Organization of the United States Customs) is evident, the territories under

the jurisdiction of the Secretaries of War and Navy having been interchanged.—A. de C.

Lancashire Sea-Fisheries Laboratory. James Johnstone Memorial Volume. University Press of Liverpool, 1934. 348 pp. Price, 21s.

The latest tendency in the cultured world in the way of honoring a scholar is the publication of a memorial volume giving evidences of the world's appreciation of his work. For this purpose the present volume was prepared to commemorate the death of James Johnstone and his retirement from the chair of Oceanography at Liverpool in 1935. It is a symposium on various matters dealing with the sea, including its physical and biological phenomena. It includes original investigations on varied oceanographic topics, written by men identified with various well-known schools of thought, both of Europe and America. The articles are independent from one another, and the only coördination among them is that they reflect the world to which Johnstone dedicated himself. In each article much useful information will be found by the oceanographer, the embryologist, the geologist, the ecologist, the parasitologist, and the physical chemist.—H. A. R.

Researches on Vitamins, 1900–1911. By Prof. Dr. G. Grijns. J. Noorduyn en Zoon N. V., Gorinchem, 1935. 254 pp.

This book was prepared to give evidence of the admiration and gratitude which the world owes Dr. G. Grijns for his valuable contributions to the science of vitamins. It is a compilation of his early works covering his investigations on polyneuritis gallinarum, with which is included his thesis on "the physiology of the nervous opticus," translated into German, and which was published while he was still a student at the University of Utrecht.

Doctor Grijns is largely to be remembered for his classical researches on beriberi. With his predecessor Erijkman, a fellow Dutchman, he is acknowledged as one of the founders of vitamin science. Considering the consequences of his investigation and the benefits which mankind reaped from them, Grijns deserves more of the world's gratitude than can be expressed by the preparation of this memorial volume.

The book, however, is more than a commemorative volume. In making the classical studies of the author accessible in English translation, the book commends itself to a large circle of readers, especially those who are making a historical study of vitamin science.—A. J. H.

THE PHILIPPINE JOURNAL OF SCIENCE

VOL. 61 OCTOBER, 1936 No. 2

COMPOSITION OF PHILIPPINE TOBACCO-SEED OIL

By AURELIO O. CRUZ and AUGUSTUS P. WEST
Of the Bureau of Science, Manila

The production of tobacco is one of the largest industries in the Philippines. The value of cigars, cigarettes, and other tobacco products exported in 1935 amounted to 12,003,658 pesos (Table 1). Large stocks were also produced for domestic consumption. Taxes collected from the tobacco industry help to a very considerable extent in financing the Government.

TABLE 1.—*Tobacco exported from the Philippines in 1935.*[a]

Product.	Quantity.	Value.
		Pesos.
Cigars	223,117,286	6,798,760
Leaf tobacco kg	22,412,659	4,614,920
Cigarettes	16,273,383	43,942
Scraps, etc. kg	1,482,173	540,247
Smoking tobacco kg	6,994	3,314
All other kinds kg	60,345	2,475
Total		12,003,658

[a] Philip. Statistical Rev. 2 (1936) 246.

Recently we investigated the oil obtained from Philippine tobacco seeds. The results showed that this oil has a composition similar to that of cottonseed oil, and quite likely it could be used for the same purposes for which cottonseed oil is employed.

Tobacco is now grown successfully in many districts in the Philippines, but the finest quality is produced in the Cagayan

Valley in northern Luzon, where the environmental conditions for growing tobacco are excellent. Cagayan River flows through this valley. During the rainy season the river rises, sometimes to a height of 40 feet, and all the lowlands are inundated. This overflow always leaves on the land a deposit of rich river silt, and thus annually renews the fertility of the soil and makes the use of fertilizer unnecessary. The tobacco plant is exceptionally sensitive to the effects of soil and climate. The uniform climate and the annual fertilization of Cagayan Valley give, with proper cultivation, a crop that shows only very slight variations from year to year. This region is certainly one of the richest in the world for growing tobacco.

The modern factories manufacturing cigars and cigarettes in Manila are considered show places for tourists. Manila cigars are noted for their mildness, and they find a ready sale locally and abroad.

A very interesting and instructive account of Philippine tobacco was published in the Philippine Agricultural Review, volume 20 (1927), first quarter. This issue is called the "tobacco number" and contains the following articles:

Notes on the manufacture of tobacco in the Philippines, by Domingo B. Paguirigan.

A study of the cost of production of tobacco in the Cagayan Valley, by Domingo B. Paguirigan and Ulpiano V. Madamba.

Wrapper tobacco production at the Pikit and Sarunayan Tobacco Experiment Stations and its relation to the Philippine tobacco problem, by Mariano E. Gutierrez.

The Bureau of Agriculture's work on tobacco, by Eduardo R. Alvarado.

A guide for visitors to the Ilagan Tobacco Experiment Station of the Bureau of Agriculture.

A guide for visitors to the Tobacco Experiment Station of the Bureau of Agriculture at Sarunayan, Dulauan, Cotabato.

An index to bulletins, circulars, and articles on tobacco published by the Bureau of Agriculture.

A descriptive list, with cultural directions, of tobacco varieties grown and distributed by the Bureau of Agriculture, is given in circular number 186 of the Philippine Bureau of Agriculture.[1]

Some important varieties of Philippine tobacco have been analyzed by Crisostomo,[2] and comparative analyses of American and Philippine cigarettes have been made by Lava and Etorma.[3]

[1] This bureau is now known as the Bureau of Plant Industry.

[2] Philip. Agri. 23 (1934) 516.

[3] Philip. Agri. 17 (1929) 565.

Several reports[4] on the constants of foreign tobacco-seed oil have been published recently.

Roberts and Schuette[5] investigated the constituents of the oil obtained from Wisconsin-grown tobacco seeds. They found that the oil consisted principally of oleic, linolic, stearic, and palmitic glycerides.

EXPERIMENTAL PROCEDURE

The Philippine tobacco seeds used in this investigation were kindly presented to us by the Compañía General de Tabacos de Filipinas, which is one of the largest tobacco companies in the Philippines. The seeds were a mixture of the Vizcaya and Espada varieties and were obtained from plants grown in the district of Cabagan (Isabela Province) in the Cagayan Valley.

As received in the laboratory, the tobacco seeds contained some stems and dust. The seeds were first passed through a coarse sieve to remove the stems and then through a fine sieve to separate out the dust. They were ground to a fine powder which was extracted with ether. The ether extract was filtered to remove the solid material, and the filtrate distilled to eliminate the ether. The tobacco-seed oil was treated successively (warming, shaking, and filtering) with kieselguhr, suchar, and talcum powder. This treatment removed vegetable fibers and colloidal matter and produced a brilliantly clear oil that had a light yellow color with a slightly greenish tinge. The yield of oil was 39.92 per cent, calculated on a moisture-free basis. The physical and chemical constants are given in Table 2.

TABLE 2.—*Physical and chemical constants of tobacco-seed oil.*

Specific gravity at $\frac{30^\circ}{4^\circ}$ C.	0.9130
Refractive index at 30° C.	1.4714
Iodine number (Hanus)	135.8
Saponification value	190.5
Unsaponifiable matter (per cent)	1.41
Acid value	16.8
Saturated acids, determined (per cent)	10.43
Unsaturated acids, plus unsaponifiable matter, determined (per cent)	83.84
Saturated acids, corrected (per cent)	9.99
Unsaturated acids, corrected (per cent)	82.87
Iodine number of unsaturated acids	153.6

[4] Kruglyakov, I., Tabachnaya Prom. (1934) No. 5, 24. Belyaev, N., Masloboino-Zhirovoe Delo (1932) No. 3, 47. Varga, I., and Géza Dedinszky, Kisérletugyi Koslemények 37 (1934) 153.

[5] Journ. Am. Chem. Soc. 56 (1934) 207.

The saturated and unsaturated acids that occur as glycerides in tobacco-seed oil were separated by the lead-salt-ether method [6] in accordance with the suggestions of Baughman and Jamieson.[7] The results are recorded in Table 3.

TABLE 3.—*Separation of saturated acids from the unsaturated acids of tobacco-seed oil by the lead-salt-ether method.*

Experiment No.	Oil used.	Unsaturated acids.	Saturated acids.	Unsaturated acids (determined).	Saturated acids (determined).	Unsaturated acids [a] (corrected).	Saturated acids (corrected).
	g.	*g.*	*g.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
1	10.2852	8.6283	1.0681	83.89	[b] 10.38	82.94	9.92
2	20.1192	16.8572	2.1073	83.79	[c] 10.47	82.80	10.05
Mean				83.84	10.43	82.87	9.99

[a] Unsaturated acids (unsaponifiable matter removed); iodine number (Hanus) 153.6.
[b] Iodine number (Hanus), 6.8.
[c] Iodine number (Hanus), 6.2.

The unsaturated acids separated from tobacco-seed oil by the lead-salt-ether method were treated with bromine and converted into their bromoderivatives.[8] No ether-insoluble hexabromide was obtained, thus showing the absence of linolenic acid.

The composition of the mixed unsaturated acids that occur as glycerides in tobacco-seed oil was calculated from the iodine number of the unsaturated acids. The results are given in Table 4. There are also included the calculated percentages of glycerides in the original oil corresponding to these individual unsaturated acids.

TABLE 4.—*Percentage composition of the unsaturated acids of tobacco-seed oil and the glycerides corresponding to these acids.*

Acid.	Mixture of unsaturated acids.	Original oil.	Glycerides in original oil.
	Per cent.	*Per cent.*	*Per cent.*
Linolic	69.55	57.64	60.23
Oleic	30.45	25.23	26.37
Total	100.00	82.87	86.60

[6] Lewkowitsch, J., Chemical Technology and Analysis of Oils, Fats, and Waxes 1 (1921) 556.

[7] Cotton Oil Press 6 (1922) 41. Journ. Am. Chem. Soc. 42 (1920) 2398.

[8] Lewkowitsch, J., Chemical Technology and Analysis of Oils, Fats, and Waxes 1 (1921) 585.

Saturated acids.—The saturated acids were separated from tobacco-seed oil by the lead-salt-ether method and esterified with methyl alcohol. The mixed acids were dissolved in methyl alcohol and saturated with dry hydrogen chloride gas. The mixture was then heated on a water bath (reflux) for fifteen hours, after which it was treated with water and the ester layer separated. The esters were dissolved in ether and the ethereal solution was washed with sodium carbonate solution and afterwards with water. The ethereal solution was then dehydrated with anhydrous sodium sulphate, filtered, and the ether removed by distilling. The impure esters (87.7062 grams), which were yellow, were distilled under diminished pressure. A preliminary distillation was first made at about 7 millimeters pressure. The esters were redistilled at 5 millimeters pressure. Data on the distillation of the esters are given in Tables 5 and 6.

TABLE 5.—*First distillation of the methyl esters of the saturated acids. (Pressure, 7 millimeters; 87.7062 grams of esters distilled.)*

Fraction.	Temperature.	Weight.
	°C.	g.
A	179–182	31.6445
B	182–187	17.9953
C	187–192	11.3749
D	192–197	12.8286
E	197–200	6.4961
Residue		7.1499
Total		87.4893

TABLE 6.—*Second distillation of the methyl esters of the saturated acids. (Pressure, 5.0 millimeters; 87.4893 grams of esters redistilled.)*

Fraction.		Temperature.	Weight.
From first distillation.	Second distillation.		
		°C.	g.
A and B	1	173–177	23.6154
C	2	177–180	18.7578
D	3	180–187	18.0404
E and residue	4	187–193	9.8511
	5	193–197	8.3775
	6	197–218	7.6228
	Residue		1.1226
Total			87.3876

The analyses of fractions obtained in the second distillation of the methyl esters are given in Table 7. From these data

there were calculated the amounts of the individual acids corresponding to the methyl esters contained in the various fractions. The results are recorded in Table 8.

TABLE 7.—*Analyses of fractions obtained in the second distillation of the mixed methyl esters.*[a]

Fraction.	Iodine number.	Saponification value.	Mean molecular weight of mixed esters.	Composition of mixed esters.		Mean molecular weight of saturated esters.
				Saturated.	Unsaturated.	
				Per cent.	*Per cent.*	
1	2.2	207.6	270.2	98.50	1.50	269.8
2	3.3	205.8	272.6	97.74	2.26	272.1
3	6.7	200.9	279.2	95.42	4.58	278.6
4	10.1	194.7	288.1	93.10	6.90	287.7
5	11.1	189.8	295.6	92.41	7.59	295.6
6	11.9	184.5	304.1	91.87	8.13	304.9

[a] Calculated iodine number of unsaturated methyl esters, 146.3; calculated saponification value of unsaturated methyl esters, 190.4.

TABLE 8.—*Saturated acids corresponding to methyl esters in each fraction.*

Fraction.	Acid.							
	Myristic.		Palmitic.		Stearic.		Arachidic.	
	Per cent.	*g.*	*Per cent.*	*g.*	*Per cent.*	*g.*	*Per cent.*	*g.*
1	1.65	0.3897	91.74	21.6648				
2			86.72	16.2668	5.99	1.1136		
3			63.66	11.4845	26.95	4.8619		
4			33.42	3.2922	55.14	5.4319		
5			8.45	0.7079	79.58	6.6668		
6					66.93	5.1019	20.72	1.5794
Residue[a]								1.0744
Total		0.3897		53.4162		23.1761		2.6538

[a] Residue assumed to be methyl arachidate.

TABLE 9.—*Saturated acids.*

Acid.	Mixture of saturated acids.[a]			Glycerides in original oil.
	Weight.	Composition.	Proportions in original oil.	
	g.	*Per cent.*	*Per cent.*	*Per cent.*
Myristic	0.3897	0.49	.05	.05
Palmitic	53.4162	67.08	6.70	7.03
Stearic	23.1761	29.10	2.91	3.04
Arachidic	2.6538	3.33	0.33	0.34
Total	79.6358	100.00	9.99	10.46

[a] When separated from tobacco-seed oil, the corrected percentage of saturated acids was 9.99.

TABLE 10.—*Comparison of Philippine tobacco-seed oil with other Philippine vegetable oils.*

Constituent.	Tobacco-seed oil.	Kapok-seed oil. [a]	Peanut oil. [b]	Cotton-seed oil. [c]
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*
Glycerides of—				
Unsaturated acids:				
Oleic	26.37	49.8	53.9	35.2
Linolic	60.23	29.3	27.0	41.7
Saturated acids:				
Myristic	0.05	0.5	----------	0.8
Palmitic	7.03	15.9	8.5	20.0
Stearic	3.04	2.3	3.6	2.0
Arachidic	0.34	0.8	3.4	0.6
Lignoceric	----------	----------	2.4	----------
Unsaponifiable matter	1.41	0.8	0.3	----------
Total	98.47	99.4	99.1	99.8

[a] Philippine kapok-seed oil (Ceiba pentandra), Cruz, A. O., and A. P. West, Philip. Journ. Sci. 46 (1931) 131.

[b] Philippine peanut oil (Valencia variety), Cruz, A. O., and A. P. West, Philip. Journ. Sci. 46 (1931) 199.

[c] American cottonseed oil, Jamieson, G. S., and W. F. Baughman, Journ, Am. Chem. Soc. 42 (1920) 1197.

In Table 9 are given the composition of the mixed saturated acids and the glycerides in the original sample of tobacco-seed oil corresponding to these acids.

The composition of Philippine tobacco-seed oil is recorded in Table 10, in which the analyses of other Philippine vegetable oils are also included for comparison. As shown by the data (Table 10) Philippine tobacco-seed oil is similar in composition to kapok, cottonseed, and peanut oils. All of these oils consist principally of glycerides of oleic, linolic, and palmitic acids. They are suitable commercially for the various purposes for which cottonseed oil is employed; that is, the high-grade oils are useful for making edible products, while the lower grades may be employed for manufacturing soap and similar commodities.

The yield of seeds from Philippine tobacco plants is comparatively small, and the oil obtained from the seeds does not contain constituents of very exceptional value. Considering these facts it would appear that the production of Philippine tobacco-seed oil as an industry is not promising.

SUMMARY

The production of tobacco is one of the leading industries in the Philippines.

The Cagayan Valley in northern Luzon is one of the best districts in the world for cultivating tobacco.

Tobacco seeds were obtained from plants grown in the Cagayan Valley. The oil extracted from these seeds had a composition similar to that of kapok, peanut, and cottonseed oils. All of these oils consist principally of glycerides of linolic, oleic, and palmitic acids, though in different proportions. Quite likely Philippine tobacco-seed oil could be used for the same purposes for which cotton-seed oil is employed.

NEW OR LITTLE-KNOWN TIPULIDÆ FROM EASTERN ASIA (DIPTERA), XXXIII[1]

By CHARLES P. ALEXANDER

Of Amherst, Massachusetts

TWO PLATES

The majority of the species discussed in the present report are from the Khasi Hills, Assam, where they were collected at Cherrapunji by Mr. S. Sircar. A few additional species are from southern Sumatra where they were secured by Mrs. M. E. Walsh. I am greatly indebted to Mrs. Walsh and Mr. Sircar for their appreciated interest in saving these usually neglected flies. The types of the novelties discussed herewith are preserved in my collection of the Tipulidæ.

TIPULINÆ

TIPULINI

TIPULA (SCHUMMELIA) MEDICA sp. nov. Plate 1, fig. 1.

General coloration brown, the præscutum obscure brownish yellow, with four darker brown stripes; antennæ bicolorous; pleura uniformly dark brown; legs black, the femoral bases yellow; wings with a weak brown tinge, with veins Cu and m-cu conspicuously seamed with dark brown; Rs short and straight, shorter than R_{2+3}; cell 1st M_2 diamond-shaped, pointed at both ends; cell M_1 rather short-petiolate; abdomen brownish black, the tergites only restrictedly brightened on their sublateral portions.

Female.—Length, about 14 millimeters; wing, 11.

Frontal prolongation of head brownish black; nasus distinct; palpi black. Antennæ with the scape obscure yellow; pedicel pale yellow; flagellum bicolorous, yellow, the basal enlargement of the segments dark brown; basal enlargements only weakly developed; verticils subequal in length to the segments; terminal segment reduced to a tiny conical structure. Head light brown, the posterior orbits narrowly more grayish; a capillary,

[1] Contribution from the entomological laboratory, Massachusetts State College.

median, dark brown vitta extends from the summit of the entire vertical tubercle backward to the occiput.

Pronotum dark brown. Mesonotal præscutum obscure brownish yellow, with four darker brown stripes, the intermediate pair separated by a vague paler median line; scutal lobes extensively darkened; scutellum testaceous brown, darker brown on either side of the midline, this color including most of the parascutella; mediotergite yellowish brown, darker laterally, the entire surface with coarse, erect black setæ. Pleura almost uniformly dark brown. Halteres with extreme base of stem pale, the remainder broken. Legs with the coxæ infuscated; trochanters yellow; remainder of legs black, the femoral bases yellow, narrowest on the fore and middle legs, much more extensive on the posterior pair. Wings (Plate 1, fig. 1) with a weak brownish tinge; prearcular field more yellowish, cells C and Sc pale brown; stigma dark brown, preceded and followed by restricted cream-colored areas; narrow but complete dark brown seams on m-cu and the entire length of vein Cu; anterior cord and outer veins very narrowly and insensibly seamed with brown; outer radial field weakly darkened, especially in cell R_3; wing apex, as far caudad as vein Cu, together with the axilla, very narrowly darkened; veins brown; obliterative areas of moderate size. Venation: Sc_2 ending just beyond origin of Rs, the latter short and straight, much shorter than R_{2+3}; veins R_{1+2} diverging strongly from R_3, cell R_2 very wide at margin; cell 1st M_2 strongly pointed at both ends, nearly diamond-shaped by the shortening of m; cell M_1 more than three times the length of its petiole; m-cu a short distance before the fork of M.

Abdomen brownish black, variegated by obscure yellow, the tergites restrictedly so on the sublateral portions; sternites more extensively pale. Cerci long and slender.

Habitat.—Assam (Khasi Hills).

Holotype, female, Cherrapunji, altitude 4,000 to 5,000 feet, August, 1935, at light (*Sircar*).

Generally similar to *Tipula* (*Schummelia*) *klossi* Edwards (Malay Peninsula), differing most evidently in the details of coloration of the body and wings, the shorter trichia of the wing veins, and in the venation, as the even more basal position of m-cu. *Tipula* (*S.*) *pendleburyi* Edwards and *T.* (*S.*) *vitalisi* Edwards are likewise related to the present fly though more distantly so.

TIPULA (SCHUMMELIA) PERGRATA sp. nov. Plate 1, fig. 2; Plate 2, fig. 25.

Belongs to the *continuata* group; antennal flagellum black, only the basal segments feebly bicolorous; præscutum with three brown stripes that are confluent in front; scutum and scutellum with a median dark vitta; pleura yellow; femora obscure brownish yellow, the tips rather narrowly blackened; wings with a faint brownish tinge, restrictedly patterned with brown and variegated by more whitish areas; Rs a little longer than R_{2+3}; m-cu shortly before the fork of M_{3+4}; male hypopygium with the inner dististyle abruptly narrowed into a small blackened apical beak, subtended beneath by an acute blackened spine; notch of ninth sternite with a depressed subcircular lobule.

Male.—Length, about 10.5 millimeters; wing, 12; antenna, about 3.5.

Frontal prolongation of head, together with the conspicuous nasus, yellow, the sides of the prolongation brownish black; palpi black. Antennæ with the scape and pedicel yellow; first flagellar segment yellow basally, darkened at outer end; succeeding two or three segments darker basally than at outer ends, the outer segments uniformly blackened; verticils a little shorter than the segments; terminal segment about one-third as long as the penultimate. Front and anterior vertex yellow, the posterior portions of vertex a little more infumed; a narrow, darker brown median line on posterior vertex, extended caudad from a small median tubercle.

Pronotum brown on median portion, yellow on sides. Mesonotal præscutum with three brown stripes that are confluent in front though narrowly separated behind, leaving linear posterior interspaces of the ground color; præscutal stripes with the central portions a little paler than the borders; humeral and lateral portions of præscutum broadly yellow; scutum broadly yellow medially, the outer portions of lobes dark brown, this being a direct continuation of the lateral præscutal stripe, the median scutal area further divided by a capillary dark central vitta; scutellum yellow, with a median brown line; parascutella dark; mediotergite pale on central portion, the sides darkened. Pleura almost uniformly yellow, scarcely or not at all variegated by darker. Halteres darkened, the extreme base of stem and apex of knob a little brightened. Legs with the coxæ and trochanters yellow; femora obscure brownish yellow, the tips rather narrowly blackened, the amount subequal on all legs; tibiæ and

tarsi black. Wings (Plate 1, fig. 2) with a faint brownish tinge, the prearcular field and cells C and Sc more yellowish brown; stigma dark brown; brown seams along veins Cu and m-cu, interrupted at near three-fourths the length of vein Cu_1 by a large pale area in cell M; anterior cord and outer end of cell 1st M_2 narrowly seamed with brown; veins beyond cord very narrowly bordered by darker; outer ends of anal cells a little darker colored than the ground; cell 1st A with a whitish marginal spot adjoining veins 1st A and 2d A; veins dark, paler in the costal region. Venation: Rs a little longer than R_{2+3}; petiole of cell M_1 a little exceeding m; m-cu long, shortly before the fork of M_{3+4}.

Abdominal tergites obscure yellow, narrowly darkened sublaterally; sternites more uniformly yellow; hypopygium infuscated. Male hypopygium (Plate 2, fig. 25) with the caudal border of the ninth tergite, *9t*, deeply and broadly emarginate, the dorsal surface rather strongly and convexly arched; border of emargination heavily blackened, without evident median tooth. Outer dististyle, *od*, long and slender, gradually narrowed outwardly, with very long outspreading setæ. Inner dististyle, *id*, with a small blackened beak, the apical point unusually slender, with an acute blackened point directed towards it. Ninth sternite, *9s*, bearing at base of its median notch a small, depressed, semicircular or oval lobule, densely set with microscopic setulæ.

Habitat.—Assam (Khasi Hills).

Holotype, male, Cherrapunji, altitude 4,000 to 5,000 feet, August, 1935, at light (*Sircar*).

The closest described allies of the present fly are *Tipula* (*Schummelia*) *continuata* Brunetti and *T.* (*S.*) *xanthopleura* Edwards, of northern India, which differ in the structure of the male hypopygium and in the venational details, as the long, more arcuated R_{2+3} and differently shaped medial cells in *continuata*, and the longer Rs, which considerably exceeds R_{2+3}, in *xanthopleura*. Edwards has given descriptions of the hypopygial distinctions of the two species mentioned.[2]

TIPULA (VESTIPLEX) TUTA sp. nov. Plate 1, fig. 3.

Mesonotum yellow, the præscutum with four more olive-brown stripes that are very vaguely bordered by slightly darker brown; scutellum and postnotum with a narrow, darkened, median vitta; pleura obscure yellow; tips of femora narrowly blackened; wings

[2] Ann. & Mag. Nat. Hist. X 1 (1928) 698–699.

strongly suffused with brownish yellow, almost unpatterned; Rs long, subequal to vein R_3; petiole of cell M_1 very short; abdominal tergites yellow, narrowly trivittate with dark brown; sternites yellow, with a median brown line; cerci slender, each with about a dozen strong teeth.

Female.—Length, about 17 millimeters; wing, 14.2.

Frontal prolongation of head obscure yellow, narrowly lined with darker on sides; nasus stout; palpi black. Antennæ with the scape and pedicel obscure yellow, flagellum brown, the basal enlargements of the segments not or scarcely darkened; longest verticils a little shorter than the segments. Head obscure orange or orange-yellow, with a vague, median, darker line on vertex.

Mesonotal præscutum yellow, with four more olive-brown stripes that are vaguely bordered by slightly darker brown; anterior ends of intermediate stripes barely confluent; scutum obscure yellow, the lobes variegated by more olive-brown; scutellum olive-brown, narrowly darker medially; postnotum more golden-yellow pollinose, with a narrow dark median vitta that is narrowed behind and does not reach the posterior margin. Pleura obscure yellow, the anepisternum a little variegated by darker. Halteres brownish yellow, the knobs dark brown. Legs with the coxæ and trochanters obscure yellow; femora brownish yellow, the tips narrowly but conspicuously blackened, the amount subequal on all legs and involving about the distal seventh or eighth of the segment; tibiæ and basitarsi obscure yellow, the tips narrowly darkened; remainder of tarsi darkened. Wings (Plate 1, fig. 3) strongly suffused with brownish yellow, the stigma and a more or less evident cloud on anterior cord a little darker than the ground; no distinct dark pattern on wing, as is the case in all other species of the subgenus; obliterative areas across cell 1st M_2 conspicuous; veins brown. Venation: Rs relatively long, subequal to vein R_3; petiole of cell M_1 very short; M_{3+4} subequal to basal section of M_3.

Abdominal tergites yellow, narrowly bordered sublaterally with dark brown, the lateral margins narrowly buffy; a continuous, dark brown, median stripe on tergites; sternites yellow, with a broad, nearly continuous, dark brown, median stripe. Ovipositor with cerci slender, each with about a dozen strong teeth along more than the distal half.

Habitat.—Assam (Khasi Hills).

Holotype, female, Cherrapunji, altitude 4,000 to 5,000 feet, August, 1935, at light (*Sircar*).

The nearest described ally of the present fly is *Tipula* (*Vestiplex*) *nigroapicalis* Brunetti, of the eastern Himalayas, readily distinguished by the different wing pattern and venation. A paratype of the latter species is before me and indicates a very different fly. The practically obsolete wing pattern of the present insect will serve to separate the species from all others so far known.

LIMONIINÆ

LIMONIINI

LIMONIA (GERANOMYIA) MERACULA sp. nov. Plate 1, fig. 4.

General color reddish, the præscutum with three narrow brown stripes; rostrum short, in the female only about one-third the length of the remainder of body, black, with a pale ring just before the very short tips of the labial palpi; legs yellow; wings whitish subhyaline, heavily patterned with brown, including a series of six major costal areas; areas two to four, inclusive, widened posteriorly and there inclosing pale centers; last dark costal area a complete subapical fascia; Sc long, Sc_1 ending just before the fork of Rs; abdominal tergites dark brown, the posterior borders of the segments narrowly pale; sternites pale.

Female.—Length, excluding rostrum, about 6 millimeters; wing, 6.5; rostrum, about 2.

Rostrum relatively short, in female only about one-third the remainder of body, black, narrowly paler just before the very short, divergent tips of the labial palpi. Antennæ short, black throughout; flagellar segments short-oval, with verticils that are subequal in length to the segments. Anterior vertex and front obscure silvery, the color continued caudad onto the posterior vertex as a silvery line of slightly greater width; posterior portion of head blackened.

Pronotum reddish brown above, more blackened on sides and as a narrow median line. Mesonotal præscutum reddish, with three very narrow brown stripes, the median one beginning on the pronotum, not attaining the suture behind; lateral stripes subequal in width to the median, reaching or passing the suture but vague and diffuse behind; scutellum, median region of scutum, and the posterior median portion of the præscutum more testaceous; postnotum reddish brown, more darkened on sides. Pleura almost uniformly reddish brown, the dorsal sclerites scarcely darker. Halteres dusky. Legs with the coxæ and trochanters yellowish testaceous; remainder of legs, yellow, only the terminal tarsal segments somewhat darker. Wings (Plate 1, fig. 4) whitish subhyaline, heavily patterned with brown, includ-

ing a series of about six major costal areas, arranged as follows: At arculus; at supernumerary crossvein in cell Sc; origin of Rs; tip of Sc_1; stigma; tip of vein R_{2+3}; of these areas the first is small and ill-defined, spreading distad in cell Sc and thence crossing cells R and M just beyond arculus; areas two to four widen out behind in cell R and here have the centers pale, the lateral darkenings appearing as pincer-shaped areas in cell R; stigmal area large and extensive, involving cell R_3; terminal area a complete subapical crossband extending from cell R_2 to cell M_4, sending a dark spur to wing apex along vein R_{4+5}; in addition to the six major areas, there are small paler areas in cells C and Sc only, lying between the major areas one and two, two and three, and three and four, respectively; narrow, solidly darkened seams along cord and outer end of cell 1st M_2; small brown spots at ends of veins Cu_1, 1st A, and 2d A, the last largest; a small darkened marginal spot at near midlength of cell 2d A; veins dark brown. Venation: Sc long, with Sc_1 ending nearly opposite the fork of Rs, Sc_2 at its tip; free tip of Sc_2 and R_2 both pale and in transverse alignment; m-cu close to fork of M; vein 2d A bent rather strongly to wing margin, the cell widest just before outer end.

Abdominal tergites dark brown, the posterior borders of the segments narrowly pale; sternites obscure yellow; genital shield chiefly pale; bases of hypovalvæ blackened.

Habitat.—Assam (Khasi Hills).

Holotype, female, Cherrapunji, altitude 4,000 to 5,000 feet, August, 1935, at light (*Sircar*).

Limonia (*Geranomyia*) *meracula* is quite distinct from the other described regional species of the subgenus, especially in the wing pattern which is very different from that of the other Indian and Malayan species. The most similar forms are *L.* (*G.*) *avocetta* (Alexander) and *L.* (*G.*) *semistriata* (Brunetti), but the resemblance is not particularly close.

LIMONIA (GERANOMYIA) FUMIMARGINATA sp. nov. Plate 2, fig. 26.

Allied to *pictorum;* size large (wing, male, 7 millimeters); general coloration of præscutum reddish brown, with three narrow darker brown stripes; pleura yellowish, the dorsal portion a little more darkened; knobs of halteres infuscated; legs yellow; wings pale yellow, with a heavy dark pattern, including six major costal areas that are pale brown, narrowly bordered by darker brown; posterior cells of wing with numerous small brown dots; Sc_1 ending opposite or shortly beyond midlength of

Rs; male hypopygium with the median notch of the tergite shallow; ventral dististyle large; rostral spines two, arising from a common tubercle.

Male.—Length, excluding rostrum, about 7 millimeters; wing, 7; rostrum, about 3.

Rostrum relatively long, nearly one-half the length of the remainder of body, black throughout; free tips of labial palpi slender. Antennæ black throughout; flagellar segments oval, with inconspicuous verticils. Head with the narrow anterior vertex gray, the color produced caudad onto the posterior vertex almost to occiput; remainder of vertex black.

Pronotum pale yellow, narrowly darkened medially above and on sides. Mesonotal præscutum reddish brown, the humeral and lateral portions paling to light yellow; disk of præscutum with three narrow darker brown stripes, the median one wider in front, narrowed behind and reaching the suture; lateral stripes subequal in width to the interspaces; scutal lobes reddish brown, their mesal portions variegated with darker brown; scutellum chiefly pale, with a narrow, darker, median vitta, the parascutella darker; mediotergite dark brown. Pleura yellowish, the dorsal portion a little more darkened, the color a little more expanded on the pleurotergite. Halteres pale, the knobs infuscated. Legs with the coxæ and trochanters tinged with green; remainder of legs yellow, the terminal tarsal segments darkened. Wings with a pale yellow tinge, the prearcular and costal regions a very little more saturated yellow; a heavy brown pattern, chiefly costal in distribution, including six major areas, arranged as follows: First at arculus; second at the supernumerary crossvein in cell Sc; third and fourth at origin of Rs and fork of Sc, respectively, in cases united with one another along Rs; fifth area stigmal; sixth at outer end of R_{2+3}; a smaller marking at outer end of cell R_3; major costal areas with their central portions paler brown than the narrow dark margins; cord and outer end of cell 1st M_2 narrowly seamed with brown; small scattered brown dots in most of the cells of the wing, including R, M, Cu, 1st A, 2d A, and, usually, in some of the cells beyond the cord; veins pale, darker in the infuscated areas. Venation: Sc_1 ending opposite or shortly beyond midlength of Rs, Sc_2 at its tip; m-cu at fork of M.

Abdominal tergites brown; sternites light yellow; hypopygium a little brightened. Male hypopygium (Plate 2, fig. 26) much as in *pictorum*. Ninth tergite, *9t*, with the median notch shallow. Ventral dististyle, *vd*, larger, the rostral prolongation

small but stout; rostral spines two, slightly unequal in size, arising from a common tubercle. Dorsal dististyle at apex produced into a long, slender, darkened spine.

Habitat.—Assam (Khasi Hills).

Holotype, male, Cherrapunji, altitude 4,000 to 5,000 feet, August, 1935, at light (*Sircar*). Paratopotype, male.

The most similar described species is *Limonia* (*Geranomyia*) *pictorum* Alexander,[3] which differs conspicuously in the smaller size and very different wing pattern, the dark costal areas being solidly infuscated, not pale in the centers with narrow darker borders, as is the case in the present species. Correlated with the above are minor differences in venation and in the structure of the male hypopygium.

LIMONIA (GERANOMYIA) OFFIRMATA sp. nov. Plate 1, fig. 5.

General coloration reddish yellow, the præscutal disk chiefly covered by three dull black, confluent stripes; femora yellow; wings grayish yellow, with a very restricted, darker brown pattern, including small spots at the supernumerary crossvein in cell Sc, origin of Rs and tip of Sc; stigma darkened; Sc_1 ending opposite two-thirds the length of Rs.

Female.—Length, excluding rostrum, about 5.5 millimeters; wing, 6.4; rostrum, about 1.7.

Rostrum unusually short, less than a third the length of the remainder of body, black throughout; divergent tips of labial palpi very short. Antennæ with the scape dark brown, the remainder of organ black; flagellar segments oval, with short inconspicuous verticils. Anterior vertex silvery, the posterior portion of head darkened.

Pronotum pale brown above, more blackened laterally. Mesonotal præscutum reddish yellow on sides and humeral portion, the disk chiefly covered by three, dull black, confluent stripes; scutal lobes dull black, the median area somewhat paler, traversed by a narrow, more blackened, median vitta; scutellum pale brown; postnotum dull black. Pleura almost uniformly yellow. Halteres with the stem yellow, the knob infuscated. Legs with the coxæ, trochanters, and femora yellow; tibiæ and tarsi darker brown, the terminal tarsal segments even darker. Wings (Plate 1, fig. 5) with an almost uniform grayish yellow suffusion, very restrictedly patterned with darker, distributed as fol-

[3] *Limonia* (*Geranomyia*) *pictorum* Alexander, Philip. Journ. Sci. 40 (1929) 247; new name for *L.* (*G.*) *pulchripennis* (Brunetti), Fauna Brit. India, Dipt. Nematocera (1912) 393; preoccupied.

lows: Three very small spots, at the supernumerary crossvein in cell Sc, origin of Rs and tip of Sc, respectively; stigmal area larger, oval; cord and outer end of cell 1st M_2 not, or at most only narrowly, seamed with darker; veins yellow, darker in the infuscated portions. Venation: Sc of moderate length, Sc_1 ending about opposite two-thirds the length of Rs, Sc_2 at its tip; supernumerary crossvein in cell Sc at near midlength of the distance between arculus and origin of Rs; free tip of Sc_2 lying a little proximad of R_2, the latter curved gently into vein R_1 to form a composite arcuated vein; m-cu close to fork of M.

Abdominal tergites dark brown, the caudal borders scarcely paler; sternites obscure yellow, with broad paler posterior margins. Ovipositor with the genital shield pale; cerci and hypovalvæ short and slender, horn-colored.

Habitat.—Assam (Khasi Hills).

Holotype, female, Cherrapunji, altitude 4,000 to 5,000 feet, August, 1935, at light (*Sircar*).

The most similar described species in the Oriental fauna are *Limonia* (*Geranomyia*) *atrostriata* (Edwards), of Formosa, and *L.* (*G.*) *notatipennis* (Brunetti), of the Abor district of northern Assam, both of which have the dark pattern of the wings restricted in a manner somewhat similar to that in the present fly. The latter species differs evidently in the coloration of the thoracic dorsum, the legs, and the wings.

ANTOCHA (ANTOCHA) PLUMBEA sp. nov. Plate 1, fig. 6.

Belongs to the *vitripennis* group; general coloration gray, the præscutal stripes poorly indicated; posterior portions of mediotergite and the ventral sternopleurite more blackened; antennæ black throughout, the terminal segment elongate; halteres pale yellow; legs black, the femoral bases restrictedly obscure yellow; wings whitish, the prearcular region more milky white; stigma oval, pale brown; veins brown, conspicuous against the ground; Rs unusually long; R_2 lying a short distance beyond level of r-m; m-cu about one-third its length before the fork of M; abdomen brownish black.

Female.—Length, about 5 millimeters; wing, 5.

Rostrum light brown; palpi black. Antennæ short, black throughout; basal flagellar segments subglobular to short-oval; intermediate segments oval; outer segments more elongate, the terminal one longest, about one-half longer than the penultimate; verticils exceeding the segments in length, except on the outer ones. Head dark gray.

Mesonotum gray, the præscutum with the usual stripes only a trifle darker and more infuscated than the ground color; scutal lobes darkened; mediotergite more blackened on posterior half. Pleura black, the surface strongly pruinose, the ventral sternopleurite more polished black; dorsopleural region darkened. Halteres pale yellow throughout. Legs with the coxæ black, pruinose; trochanters testaceous-yellow; remainder of legs black, only the femoral bases narrowly obscure yellow, the amount subequal on all legs. Wings (Plate 1, fig. 6) whitish, the prearcular region clearer milky white; cells C and Sc a trifle more yellow; stigma oval, pale brown; veins brown, distinct against the ground, pale in the prearcular and costal areas. Vein R_3 with trichia only on about the distal fourth. Venation: Rs unusually long, approximately twice R alone; R_2 relatively short and pale, traversing the outer end of stigma, subequal in length to R_{1+2} and lying distinctly beyond the level of r-m; cell 1st M_2 small; m-cu about one-third its length before the fork of M.

Abdomen brownish black; valves of ovipositor brownish horn-color.

Habitat.—Sumatra (south).

Holotype, female, Tandjong Sakti, Benkoelen, altitude 1,650 to 2,000 feet, June 1 to 10, 1935 (*Walsh*).

Antocha (*Antocha*) *plumbea* is most generally similar to *A.* (*A.*) *javanensis* Alexander, of western Java, differing especially in the dark plumbeous-gray coloration, black antennæ and legs, and the slightly longer Rs.

ANTOCHA (ANTOCHA) BASIVENA sp. nov. Plate 1, fig. 7; Plate 2, fig. 27.

Belongs to the *nigribasis* group; general coloration pale yellow, the thorax unmarked; vertex darkened medially; legs pale brown; wings tinged with pale cream-color; stigma brown; R_{2+3} short; cell 1st M_2 small, shorter than any of the veins issuing from it; m-cu far before the fork of M; male hypopygium with the inner gonapophysis appearing as very flattened, long-oval spatulas; outer apophysis a pale sinuous rod, its distal end slightly expanded, the tip acute.

Male.—Length, about 2.6 to 3 millimeters; wing, 3 to 3.5.

Rostrum obscure yellow; palpi brown. Antennæ brown throughout; flagellar segment oval, with short verticils. Head yellow, the vertex darkened medially.

Entire thorax very pale yellow, unmarked. Halteres pale yellow. Legs with the coxæ and trochanters yellow; remainder of legs uniformly pale brown, the terminal tarsal segments scarcely

darkened. Wings (Plate 1, fig. 7) tinged with pale cream-color, the radial field more whitened; stigma oval, brown, relatively conspicuous against the ground; veins pale brown. Venation: Sc ending at near three-fourths the length of the long Rs; R_2 subequal to R_{1+2} and a little shorter than R_{2+3}; cell 1st M_2 small, shorter than any of the veins issuing from it; m-cu unusually far basad, more than its own length before the fork of M.

Abdomen uniformly yellow. Male hypopygium (Plate 2, fig. 27) with the outer dististyle, *od*, a gently curved pale blade, the apex narrowly rounded. Inner dististyle, *id*, pale, a little longer than the outer, with conspicuous pale setæ on outer half. Inner gonapophysis, *ig*, a very broadly flattened, long-oval spatula; outer apophysis, *og*, a slender, sinuous, pale rod, a little widened towards outer end, the long-produced apex acute.

Habitat.—Assam (Khasi Hills).

Holotype, male, Cherrapunji, altitude 4,000 to 5,000 feet, August, 1935, at light (*Sircar*). Paratopotype, male.

Antocha (*Antocha*) *basivena* is readily told from the other Indian species of the *nigribasis* group by the small size, unmarked wings, venation, and structure of the gonapophyses of the male hypopygium.

All of the species of *Antocha* described from British India (Himalayan Region) by Brunetti belong to the *vitripennis* group, having vein R_2 in approximate transverse alignment with r-m and with m-cu close to the fork of M. These species include *Antocha* (*Antocha*) *indica* Brunetti, *A.* (*A.*) *triangularis* (Brunetti), and *A.* (*A.*) *unilineata* Brunetti. Four additional members of the genus recently taken in the Khasi Hills, Assam, by Mr. Sircar belong to the *nigribasis* group, distinguished by having vein R_2 lying somewhat proximad of the level of r-m, so that vein R_{2+3} is short to very short, and with m-cu placed at a considerable distance before the fork of M. Except for the closed cell 1st M_2, the venation of the various members of this group is almost exactly like that of members of the subgenus *Orimargula* Mik.

The four species mentioned may be distinguished by means of the accompanying key.

1. Femora pale yellow, the tips narrowly and abruptly blackened; wings with a restricted dark pattern, in addition to the stigmal darkening, best evidenced by narrow seams along the cord .... 2.
   Femora uniformly pale brown or with the tips only insensibly darkened; wings unmarked except for the small stigmal area .... 3.

2. Prearcular field of wing and cell Sc to opposite the origin of Rs blackened .... *A.* (*A.*) *khasiensis* Alexander.
   Prearcular field of wing and cell Sc entirely clear.
   A. (*A.*) *sparsipunctata* sp. nov.
3. Thorax entirely pale yellow, immaculate; cell 1st M_2 small, shorter than any of the veins issuing from it.................... *A.* (*A.*) *basivena* sp. nov.
   Thorax yellow, the præscutum with a brown median stripe; cell 1st M_2 larger, subequal in length to vein M_4 beyond it.
   A. (*A.*) *scelesta* sp. nov.

ANTOCHA (ANTOCHA) SCELESTA sp. nov. Plate 1, fig. 8; Plate 2, fig. 28.

Belongs to the *nigribasis* group; general coloration obscure brownish yellow, the præscutum with a conspicuous, dark brown, median stripe; pleura with ventral anepisternum and ventral sternopleurite weakly darkened; wings milky white, unmarked except for the small, irregular, pale brown stigma; m-cu approximately its own length before the fork of M; male hypopygium with the outer dististyle at apex produced into a spikelike point; outer gonapophysis slender, nearly parallel-sided on distal portion, the tip acute.

Male.—Length, about 3.5 millimeters; wing, 3.8.

Female.—Length, about 4.5 millimeters; wing, 4.

Rostrum obscure yellow; palpi dark brown. Antennæ short; scape obscure yellow; flagellum brownish black; flagellar segments oval. Head reddish brown, the front, anterior vertex, and posterior orbits more buffy.

Pronotum dark brown medially, paling to yellow on the sides. Mesonotum obscure brownish yellow, the præscutum with a conspicuous, dark brown, median stripe, widest in front, suddenly narrowed behind, becoming obsolete before the suture; no trace of lateral stripes; mediotergite a little darkened, especially behind. Pleura obscure yellow, the ventral anepisternum and ventral sternopleurite slightly darkened. Halteres pale yellow throughout. Legs with the coxæ and trochanters yellow; femora obscure yellow, the tips narrowly and very insensibly darkened; tibiæ a little darker than the yellow tarsi. Wings (Plate 1, fig. 8) with the ground color milky white, the prearcular and costal portions a trifle more cream-colored; veins pale brown, even lighter colored in the creamy areas; stigma small and irregular in outline, pale brown. Venation: R_{2+3} short, as in the group, only about one-third of the basal section of R_{4+5}; cell 1st M_2 of moderate size, about as long as vein M_4 beyond it; m-cu approximately its own length before the fork of M.

Abdomen pale brown, the sternites and hypopygium a trifle more yellow. Male hypopygium (Plate 2, fig. 28) with the outer dististyle, *od*, rather strongly curved, at apex produced into a long, spikelike point. Outer gonapophysis, *og*, slender, very gently curved, beyond the slightly dilated basal portion nearly parallel-sided for its entire length, the tip narrowed to an acute point.

Habitat.—Assam (Khasi Hills).

Holotype, male, Cherrapunji, altitude 4,000 to 5,000 feet, August, 1935, at light (*Sircar*). Allotopotype, female.

The closest ally is *Antocha* (*Antocha*) *basivena* sp. nov., which differs especially in the uniformly pale yellow coloration, the details of venation, and the structure of the male hypopygium, notably of the outer dististyle and gonapophyses. The other related regional species may best be separated by the key given under the account of the preceding species.

ANTOCHA (ANTOCHA) SPARSIPUNCTATA sp. nov. Plate 1, fig. 9.

Belongs to the *nigribasis* group; general coloration pale yellow, including the entire thorax and abdomen; tips of femora and tibiæ narrowly darkened; wings pale yellow, the prearcular, costal, and subcostal areas pale; a restricted dark pattern at origin of Rs, stigma, cord, and outer end of cell 1st M_2; R_{2+3} short, m-cu more than its length before the fork of M; male hypopygium with the outer dististyle slender, the tip subacute.

Male.—Length, about 4 millimeters; wing, 4.5.

Rostrum yellow; palpi dark brown. Antennæ brown throughout; flagellar segments oval. Head darkened above.

Entire thorax pale yellow, unmarked. Halteres pale yellow. Legs yellow, femoral tips narrowly dark brown, the amount of color subequal on all legs; tibiæ yellow, tips more narrowly darkened; tarsi yellow, the outer segments infuscated. Wings (Plate 1, fig. 9) almost uniformly suffused with pale yellow, the prearcular and costal portions a very little more brightened; a restricted dark pattern, distributed as follows: Origin of Rs; cord and outer end of cell 1st M_2; veins pale, darkened in the infuscated portions; veins beyond cord somewhat darker in color than most of the more basal veins. Venation: R_2 lying far before level of r-m; R_{2+3} shortened; m-cu more than its own length before the fork of M.

Abdomen, including hypopygium, entirely pale yellow. Male hypopygium much as in *khasiensis*, the outer dististyle somewhat more slender, with the apex subacute.

Habitat.—Assam (Khasi Hills).

Holotype, male, Cherrapunji, altitude 4,000 to 5,000 feet, August, 1935, at light (*Sircar*). Paratopotype, male.

Antocha (*Antocha*) *sparsipunctata* finds its closest relative in *A.* (*A.*) *khasiensis* Alexander, which differs in the darkened wing base and cell Sc, slightly different body coloration, and the short and broad outer dististyle of the male hypopygium, with the apex obtusely rounded.

ANTOCHA (ORIMARGULA) PRÆSCUTALIS sp. nov. Plate 1, fig. 10.

General coloration of thorax reddish brown, the præscutum dark brown on median portion in front; lateral margin of præscutum behind the humeral region with a large velvety-black spot; thoracic pleura pruinose, with very large velvety-black areas covering most of the anepisternum and pleurotergite; halteres yellow; legs with the femora brown, the tibiæ light brown with the tips narrowly darkened; wings pale gray, the prearcular area paler; stigma darker; veins brown; abdomen brown, the bases of the individual sternite paler.

Male.—Length, about 4.5 to 5 millimeters; wing, 5 to 5.3.

Female.—Length, about 5 millimeters; wing, 6 to 6.2.

Rostrum brown; palpi black. Antennæ black, the basal segment more pruinose; flagellar segments oval, with a dense white pubescence and short verticils; terminal segment a trifle longer than the penultimate. Front and anterior vertex light gray pruinose; remainder of head dark gray.

Cervical sclerites dark brown, paler laterally. Pronotum yellow. Mesonotal præscutum reddish brown, broadly darker brown on median portion in front, this color paling to the ground color before midlength of the sclerite; lateral border of præscutum behind the humeral region with a large velvety-black spot; scutum and scutellum grayish brown, the latter brightened on caudal portion; mediotergite chiefly dark brown. Pleura reddish, heavily pruinose, with two large velvety-black areas, one occupying most of the anepisternum, the other most of the pleurotergite. Halteres pale yellow throughout. Legs with the coxæ brownish yellow; trochanters yellow; femora brown; tibiæ light brown, the tips narrowly darker brown, the amount subequal on all legs; tarsi brownish yellow to pale brown. Wings (Plate 1, fig. 10) with a pale grayish tinge, the prearcular area paler; stigma long-oval, pale brown; veins brown, the anterior branch of Rs and R_2 paler. Venation: Rs a little longer than R alone, gently convex; R_2 a little shorter than the slightly

more arcuated R_{2+3}; petiole of cell M_3 about one-half m-cu, the latter a little more than its own length before the fork of M.

Abdomen brown, the bases of the sternites a little more yellowish brown; hypopygium light yellow.

Habitat.—Sumatra (south).

Holotype, male, Moeara Tenam, Benkoelen, June 16 to 23, 1935 (*Walsh*). Allotopotype, female, with the type. Paratopotypes, 2 males, July 4 to 14, 1935. Paratypes, 2 females, Tandjong Sakti, Benkoelen, altitude 1,650 to 2,000 feet, June 1 to 10, 1935 (*Walsh*).

Antocha (*Orimargula*) *præscutalis* is most nearly allied to *A.* (*O.*) *maculipleura* Edwards, of Mount Kinabalu, northern Borneo, which has similar velvety-black spots on the thoracic pleura. The present fly is distinguished by its smaller size and the presence of a third conspicuous velvety-black area on the lateral margin of the præscutum.

HELIUS (HELIUS) LECTUS sp. nov. Plate 1, fig. 11.

General coloration pale yellow, without conspicuous markings; antennæ brownish black throughout; head gray; legs brownish yellow to pale brown; wings strongly tinged with yellow, the stigma pale, barely indicated; anterior branch of Rs sinuous, bent gently caudad opposite the stigma; cell 1st M_2 elongate, subrectangular, a little longer than vein M_4 beyond it; abdomen yellow, the tergal incisures and pleural membrane a little darkened.

Female.—Length, including rostrum, about 6.5 millimeters; wing, 6.

Rostrum a little longer than the remainder of head, obscure yellow; palpi pale brown. Antennæ brownish black throughout; flagellar segments short-oval, with inconspicuous verticils. Head gray; anterior vertex narrow, subequal to the diameter of the scape.

Cervical sclerites elongate, light brown. Pronotum and mesonotum uniform yellow to testaceous-yellow, without markings. Pleura testaceous-yellow. Halteres pale, the knobs a little darkened. Legs with the coxæ and trochanters testaceous-yellow; remainder of legs long and slender; femora brownish yellow, the tips scarcely darkened; tibiæ pale brown; tarsi obscure yellow. Wings (Plate 1, fig. 11) with a strong yellow tinge, the prearcular and costal portions a little brighter; stigma pale, barely indicated against the ground; veins brownish yellow. Macrotrichia on vein R_{1+2}, R_3, R_5, M_{1+2} and outer portions of M_3. Venation: Sc_2 ending opposite r-m, much longer than Sc_1 which is

very short to virtually lacking; anterior branch of Rs sinuous, bent gently caudad opposite the stigma, the distal end more or less parallel to vein R_{1+2}, cell R_2 narrow at margin; cell 1st M_2 elongate, subrectangular, slightly exceeding vein M_4 beyond it; m-cu nearly one-half its length beyond the fork of M.

Abdomen yellow, the lateral region and incisures of the tergites restrictedly darkened; sternites more uniformly pale yellow. Ovipositor with valves elongate, horn-colored.

Habitat.—Assam (Khasi Hills).

Holotype, female, Cherrapunji, altitude 4,000 to 5,000 feet, August, 1935, at light (*Sircar*).

The most similar regional species is the much larger *Helius* (*Helius*) *ferruginosus* (Brunetti), which differs in the dark body coloration and in the venation, such as the more elongate Rs and uniformly arched anterior branch of Rs, with cell R_2 at margin less than one-third as extensive as cell R_3. I am basing the above statements on a comparison of the type of *lectus* with metatypical specimens of *ferruginosus*. The latter are from lower altitudes of the Darjiling district, eastern Himalayas, altitude 2,000 to 4,500 feet, and may not be conspecific with the actual type of *ferruginosus*, which was from the Dawna Hills, Lower Burma. I believe the material is correctly named, since the venation agrees closely with that of the type as figured by Bagchi.[4]

HELIUS (HELIUS) SELECTUS sp. nov. Plate 1, fig. 12.

General coloration black, the præscutum with four more reddish brown stripes; rostrum black; antennæ black throughout; halteres and legs black, the femoral bases and outer tarsal segments paler; wings weakly suffused with brown, the stigma and costal border darker; cell 1st M_2 shorter than any of the veins issuing from it; abdominal tergites black, sternites yellow, the subterminal segments obscure.

Female.—Length, including rostrum, about 8 millimeters; wing, 7.5.

Rostrum black, a little longer than the remainder of head. Antennæ black throughout; flagellar segments oval, the outer segments more elongate; verticils subequal in length to the segments. Head black.

Cervical region and pronotum black. Mesonotal præscutum brownish black, with four more reddish brown stripes, the in-

[4] Brunetti, Fauna Brit. India, Diptera Nematocera (1912) pl. 8, fig. 8.

termediate pair only narrowly separated by a capillary dark vitta; scutal lobes dark brown, the median area obscure yellow; scutellum brownish black; mediotergite dark liver brown. Pleura with the dorsal sclerites and the pleural membrane brownish black; the ventral portion, including the outer half of the fore coxæ, ventral sternopleurite, and meron, obscure yellow. Halteres black. Legs obscure yellow, the fore coxæ darkened on proximal half; trochanters obscure yellow; legs black, the femoral bases restrictedly brightened, the outer tarsal segments paling to obscure brownish yellow. Wings (Plate 1, fig. 12) with a weak brown suffusion, the stigma long-oval, darker brown; cell C brownish yellow, cell Sc a little more darkened; veins dark brown. Costal fringe (female) dense but relatively short; virtually complete series of trichia on Rs and branches, and on outer sections of all medial veins. Venation: Sc_1 with distal end atrophied, Sc_2 close to its tip; Rs long and nearly straight; anterior branch of Rs gently but evenly arcuated, narrowing cell R_2 opposite the stigma, the tip of the vein very gently upcurved; cell R_3 at margin a little less than three times cell R_2; cell 1st M_2 relatively small, short-rectangular, its lower face (M_{3+4}) shorter than any of the veins issuing from the cell; m-cu a short distance before the fork of M.

Abdominal tergites black, the sternites yellow, with the subterminal segments more obscure. Genital shield of ovipositor darkened; valves yellowish horn-colored.

Habitat.—Assam (Khasi Hills).

Holotype, female, Cherrapunji, altitude 4,000 to 5,000 feet, August, 1935 (*Sircar*).

Allied to *Helius* (*Helius*) *nigriceps* Edwards and related forms, differing in the large size, body coloration, and wing venation.

ORIMARGA (ORIMARGA) DISTIVENULA sp. nov. Plate 1, fig. 13.

General coloration brown, the pleura more brownish yellow; wings relatively broad, faintly tinged with brown, the entire costal border narrowly more yellowish; no macrotrichia on anterior branch of Rs; Sc_1 ending almost opposite fork of Rs; free tip of Sc_2 lying distad of R_2; m-cu just beyond midlength of Rs.

Male.—Length, about 4.5 millimeters; wing, 4.4.

Rostrum brown; palpi black. Antennæ black throughout; flagellar segments oval. Head dark brown, the front and anterior vertex a little brighter; anterior vertex relatively wide.

Pronotum dark brown. Mesonotum uniformly brown, without stripes, the lateral portions of præscutum a little brightened.

Pleura brownish yellow. Halteres white, the knobs infuscated. Legs with the coxæ and trochanters yellow; remainder of legs dark brown, the tarsi a little brightened. Wings (Plate 1, fig. 13) relatively broad, faintly tinged with brown, the entire costal border narrowly more yellowish; veins pale brown, a trifle more yellowish in the costal field. Costal fringe relatively short; no macrotrichia on anterior branch of Rs; a series of about fifteen on distal section of vein R_{4+5}; sparse, scattered trichia on outer ends of veins M_{1+2} and M_3; remaining veins beyond cord without trichia. Venation: Sc long, Sc_1 ending almost opposite the fork of Rs, Sc_2 a short distance from its tip; free tip of Sc_2 lying distad of level of R_2; Rs long, nearly twice the basal section of R_{4+5}; R_{2+3} shorter than the basal section of R_{4+5}, subequal to R_{1+2}; m-cu just beyond midlength of Rs; vein 2d A long.

Abdominal tergites dark brown; sternites more testaceous-yellow; hypopygium broken.

Habitat.—Assam (Khasi Hills).

Holotype, male, Cherrapunji, altitude 4,000 to 5,000 feet, August, 1935 (*Sircar*).

Orimarga (*Orimarga*) *distivenula* is very distinct from the other species of the genus in eastern Asia, the chief characters being its broad wings with vein Sc of unusual length and the distal position of the free tip of Sc_2. In all other species of the genus the latter element is either atrophied or lies opposite to some distance before the level of R_2. The present instance is of unusual interest in that it parallels the condition found in the allied genus *Limonia,* where numerous species are known that have the free tip of Sc_2 migrated distad beyond the level of R_2.[5]

ORIMARGA (ORIMARGA) SUBBASALIS sp. nov. Plate 1, fig. 14.

Closely allied to *basalis;* general coloration of mesonotum gray pruinose; knobs of halteres weakly darkened; legs brownish black; wings narrow, weakly suffused with gray, the prearcular field restrictedly brightened; numerous macrotrichia on veins beyond cord; Sc long, free tip of Sc_2 faint; R_{2+3} long, exceeding the strongly arcuated Rs.

Female.—Length, about 7 to 7.5 millimeters; wing, 6.

[5] Alexander, C. P., The interpretation of the radial field of the wing in the nematocerous Diptera, with special reference to the Tipulidæ, Proc. Linn. Soc. New South Wales 52 (1927) 42–72, 92 figs.—A comparison of the systems of nomenclature that have been applied to the radial field of the wing in the Diptera, IVth Internat. Cong. Ent., Trans. 2 (1929) 700–707, 3 pls.—In Curran, C. H., The families and genera of North American Diptera (1934) 38–39, figs.

Rostrum obscure yellow; palpi black. Antennæ black throughout; flagellar segments oval, with a short, dense, white pubescence; terminal segment shorter than the penultimate. Head dark gray, more silvery on the front; anterior vertex relatively narrow, slightly blackened.

General coloration of mesonotum gray pruinose, the central portion of præscutum a little darker; median region of scutum slightly paler gray. Pleura brown, the extensive sternopleurite much paler, sparsely pruinose. Halteres white, the knobs weakly darkened. Legs with the coxæ reddish yellow, the fore coxæ slightly darker; trochanters yellowish brown; femora brownish black, the bases narrowly and vaguely brightened; tibiæ and tarsi brownish black. Wings (Plate 1, fig. 14) narrow, weakly suffused with gray, the prearcular field restrictedly whitened; veins pale brown. Macrotrichia abundant on veins beyond cord, there being more than fifty-five on distal section of R_{4+5}, more crowded towards outer end of vein. Venation: Sc long, Sc_1 ending a short distance before fork of Rs, Sc_2 close to its tip; free tip of Sc_2 faint, a distance before R_2 about equal to the length of vein R_{1+2}; R_{2+3} long, exceeding the strongly arcuated Rs; R_{1+2} a little less than one-half R_{2+3}; cell M_3 longer than its petiole; m-cu placed unusually far basad, opposite the origin of Rs or nearly so.

Abdominal tergites dark brown; sternites obscure yellow to reddish yellow. Ovipositor with tergal shield pale; valves darker.

Habitat.—Assam (Khasi Hills).

Holotype, female, Cherrapunji, altitude 4,000 to 5,000 feet, August, 1935, at light (*Sircar*). Paratopotypes, 2 females.

Orimarga (*Orimarga*) *subbasalis* is most closely allied to *O.* (*O.*) *basalis* Alexander (Kashmir), agreeing closely in the venation and trichiation of the veins, differing most evidently in the darkened knobs of the halteres, brownish black femora, and gray wings with more evidently darkened veins. In *basalis* the halteres are whitish throughout, the femora are pale with a poorly indicated darker subterminal ring, and the wings are pale yellow, with yellow veins.

PEDICIINI

NIPPONOMYIA KHASIANA sp. nov. Plate 1, fig. 15; Plate 2, fig. 29.

General coloration yellow, the præscutum and scutum with a pattern of eight black spots arranged in a circle; femora entirely yellow; tibiæ yellow, the tips narrowly blackened; wings whitish hyaline, with a clear yellow submarginal stripe extending from

the wing base to near apex; costal cell with four brown spots, the outermost at tip of vein Sc_1; no continuous dark seam on cord; cell M_2 open by atrophy of m.

Male.—Length, about 9 millimeters; wing, 8.5.

Female.—Length, about 10 to 11 millimeters; wing, 8.

Rostrum and palpi yellow. Antennæ yellow, only the terminal flagellar segments a very little more infuscated; flagellar segments short and crowded. Head uniformly pale yellow.

Mesonotal præscutum yellow, with three more polished yellow stripes and a transverse series of four circular black spots, the intermediate pair placed just behind midlength of the sclerite, the lateral pair a little nearer the suture, gently curving the row; scutum with lobes deep yellow, variegated on cephalic-lateral portion and again on posterior-median area of each lobe by a circular black spot; the eight marks on the præscutum and scutum thus form a short-oval figure but with no additional darkened sutural area, as in *novempunctata*; posterior sclerites of notum uniformly yellow. Pleura pale yellow throughout. Halteres yellow. Legs yellow, the femora entirely unvariegated; tips of all tibiæ narrowly but conspicuously blackened, the amount subequal on all legs; tarsi yellow, the tips of the individual basal segments narrowly darkened; outer tarsal segments uniformly infuscated. Wings (Plate 1, fig. 15) whitish hyaline, with the usual clear yellow submarginal stripe extending from the wing base to near apex, bordered both above and below by a narrow brown streak; clear portion of costal cell without black dashes but with four brown extensions, the last at tip of Sc_1; extreme wing tip clear; cord virtually undarkened, with a narrow seam on m-cu; vein Cu narrowly bordered with brown on basal portion; veins pale, darker in the clouded areas. Venation: As in the genus; basal section of R_5 very short to virtually lacking; cell M_2 open by atrophy of m; m-cu at or close to fork of M.

Abdomen obscure yellow, the tergites very vaguely darkened at bases. Male hypopygium (Plate 2, fig. 29) with the dististyle, *d*, trispinous. Interbase, *i*, as figured, expanded on basal portion.

Habitat.—Assam (Khasi Hills).

Holotype, male, Cherrapunji, altitude 4,000 to 5,000 feet, August, 1935, at light (*Sircar*). Allotopotype, female. Paratopotypes, 2 females.

Nipponomyia khasiana is very different from the only species of the genus hitherto discovered in India, *N. novempunctata*

(Senior-White)[6] likewise from the Khasi Hills. By my key to the known species of *Nipponomyia*,[7] the present fly runs to couplet 6, including *trispinosa* (Alexander), of Japan, and *sumatrana* (de Meijere), of Sumatra. It is readily told by the pattern of the thorax, legs, and wings, and by the open cell M_2. The fly is one of the smallest species of the genus so far discovered.

HEXATOMINI

ADELPHOMYIA (ADELPHOMYIA) DISCALIS sp. nov. Plate 1, fig. 16; Plate 2, fig. 30.

General coloration pale yellow; antennæ 16-segmented, the scape and pedicel brownish black, the flagellum obscure yellow; halteres and legs yellow; wings pale yellow, the anterior cord restrictedly darkened, the color including the veins; no trichia in cells of wing; Rs long, arcuated at origin; R_{2+3+4} short; R_{2+3} subequal to R_2; cell M_1 present; male hypopygium with the basistyle produced apically into a subacute spine; outer dististyle trispinous at apex.

Male.—Length, about 4.8 to 5.2 millimeters; wing, 5.5 to 6.

Female.—Length, about 6 millimeters; wing, 6.

Rostrum dark; palpi black. Antennæ 16-segmented; scape and pedicel brownish black, flagellum obscure yellow; flagellar segments gradually becoming more slender and elongate outwardly, the longest verticils of the outer segments subequal in length to the segments themselves. Head obscure yellow; eyes (male) large, restricting the anterior vertex.

Entire thorax uniformly pale yellow. Halteres pale yellow throughout. Legs yellow, the terminal two tarsal segments darker. Wings (Plate 1, fig. 16) uniformly pale yellow, variegated only by a restricted dark cloud on the anterior cord, most evident in the dark brown veins of the area; remaining veins yellow. Wing widest just basad of end of vein 2d A; no macrotrichia in outer cells of wing. Venation: Sc_1 ending nearly opposite fork of Rs, Sc_2 removed a short distance from its tip; Rs long, arcuated at origin; R_{2+3+4} relativey short, nearly twice the length of R_{2+3}, the latter subequal to or longer than R_2; r-m relatively long, arcuated; cell M_1 small, less than one-half its petiole; m-cu at near midlength of lower face of cell 1st M_2; vein 2d A long, ending beyond the level of origin of Rs.

Abdomen, including hypopygium, yellow. Male hypopygium (Plate 2, fig. 30) with the basistyle, *b*, produced caudad beyond

[6] Senior-White, Mem. Dept. Agr. India, Ent. Ser. 8 (1922) 138–139.
[7] Alexander, C. P., Philip. Journ. Sci. 56 (1935) 551–552.

the point of insertion of the dististyles, the apex subspinous, with long coarse setæ almost to the tip. Outer dististyle, *od*, trispinous at apex. Inner dististyle, *id*, broad at base, narrowed to the obtuse tip.

Habitat.—Assam (Khasi Hills).

Holotype, male, Cherrapunji, altitude 4,000 to 5,000 feet, August, 1935, at light (*Sircar*). Allotopotype, female. Paratopotypes, 3 males.

Adelphomyia (*Adelphomyia*) *discalis* is very distinct from the other known Asiatic species of the genus in the pale yellow wings with a single restricted darkened cloud on disk, and in the lack of macrotrichia in the cells of the wing. All other species of the genus so far made known have at least a few trichia in the outer radial of medial fields. The structure of the male hypopygium of the present fly is entirely as in the genus, and there can be no question as to the systematic position of the species.

ADELPHOMYIA (ADELPHOMYIA) SUBNEBULOSA sp. nov. Plate 1, fig. 17; Plate 2, fig. 31.

Allied to *nebulosa;* general coloration brownish black; antennæ with basal five segments yellow, the remainder black; femora blackened outwardly, with a narrow, pale yellow, subterminal ring; tibiæ dark brown, the extreme base and tip pale; tarsi brownish yellow; wings cream-yellow, with a heavy clouded brown pattern, including three virtually complete crossbands on the basal third; all veins at wing margin with large clouds; R_2 some distance before fork of R_{3+4}; cell M_1 longer than its petiole; anal veins strongly curved to margin; male hypopygium with basistyle terminating in a slender blackened spine.

Male.—Length, about 4.8 millimeters; wing, 5.

Rostrum and palpi black. Antennæ 16-segmented; scape, pedicel, and basal three flagellar segments light yellow, the remainder of flagellum black; flagellar segments becoming long-cylindrical, with long conspicuous verticils that exceed the segments in length. Head brownish black, the anterior vertex paler.

Mesonotum almost uniform brownish black, the surface polished; humeral region of præscutum restrictedly obscure brownish yellow. Pleura brownish black, with a silvery longitudinal stripe across the dorsal sternopleurite and ventral pteropleurite, ending before the halteres. Halteres with base of stem and the knob yellow, the remainder of stem dusky. Legs with the coxæ and trochanters obscure yellow; femora obscure yellow

basally, passing into black at (on forelegs) or beyond (middle and hind legs) midlength, with a narrow, light yellow, subterminal ring placed at about its own length before the black apex; tibiæ dark brown, the base very narrowly, the tip a little more broadly, whitened, the subbasal portion of the segment a little more intensely darkened; tarsi brownish yellow, the terminal two segments darker. Wings (Plate 1, fig. 17) obscure cream-yellow, with a heavy clouded brown pattern, including three narrow, virtually complete crossbands on proximal third, the first arcular, the third extending from costa opposite origin of Rs to end of vein 2d A; on central portion of disk, these bands more diffuse and interconnected in cells M and Cu; other more isolated, dark costal spots at Sc_2, R_2, and tip of R_{1+2}, the latter two inclosing a small pale spot, behind becoming confluent and suffusing the entire cord; other small clouds at outer end of cell 1st M_2 and fork of M_{1+2}; a series of marginal brown clouds at ends of all longitudinal veins, smallest on R_{4+5} and M_1, becoming progressively larger behind, most extensive on the anal veins; proximal third of cell R_4 clouded; veins pale, darkened in the suffused areas. Rather restricted macrotrichia in outer cells of wing, including cell R_2 beyond vein R_2, and in the outer ends of cells R_3 to 2d M_2, inclusive. Wings (male) widest opposite the end of cell 1st A. Venation: Sc_2 removed to some distance from the tip of R_{1+2}; R_2 oblique, some distance from fork of R_{3+4}; tips of veins R_3 and R_4 bent rather strongly cephalad, of the medial, cubital, and anal veins, strongly caudad, especially the last; basal section of M_{1+2} reduced to a point, narrowing the base of cell 1st M_2, r-m correspondingly lengthened; cell M_1 deeper than its petiole; m-cu about one-half its length beyond the fork of M.

Abdomen black; hypopygium a trifle paler, more brownish black. Male hypopygium (Plate 2, fig. 31) with the basistyle, *b*, terminating abruptly in a slender blackened spine. Outer dististyle, *od*, slender, with two outer, terminal, curved spines and an inner straight point.

Habitat.—Assam (Khasi Hills).

Holotype, male, Cherrapunji, altitude 4,000 to 5,000 feet, August, 1935, at light (*Sircar*). Paratopotypes, males.

The only near ally of the present fly is *Adelphomyia* (*Adelphomyia*) *nebulosa* (de Meijere), of western Java, which has the venation of the radial and medial fields almost the same as in the insect under consideration. This latter species differs most evidently in the details of pattern of the legs and wings.

From de Meijere's figure of the type of *nebulosa*,[8] it appears that in this species the macrotrichia of the cells of the wing are more numerous and that the anal veins are not strongly curved into the wing margin. It is certain that the generic name *Oxydiscus*, proposed by de Meijere for this fly, must fall as a strict synonym of *Adelphomyia*, the male hypopygium being entirely distinctive.

LIMNOPHILA (DICRANOPHRAGMA) MULTIGEMINATA sp. nov. Plate 1, fig. 18; Plate 2, fig. 32.

General coloration of mesonotum reddish brown, the posterior sclerites and the pleura more blackened; antennæ black, the pedicel and first flagellar segment yellow; legs yellow, the femora with a very indistinct darker subterminal ring; wings broad in male, narrower in female, pale yellow, heavily patterned with dark brown, the areas restricted to the vicinity of the veins; markings along cord and at the supernumerary crossvein in cell R_3 more extensive and subtended on either side by smaller dark dots; a series of subterminal brown spots in cells R_4 to 1st A; abdomen black, the hypopygium more brightened.

Male.—Length, about 5.5 millimeters; wing, 6.

Female.—Length, about 6.5 to 6.8 millimeters; wing, 6 to 6.2.

Rostrum and palpi black. Antennæ short in both sexes; scape black; pedicel and first flagellar segment light yellow; remainder of flagellum black; flagellar segments oval, becoming more slender and elongate outwardly. Head black.

Pronotum dark brown. Mesonotal præscutum reddish brown, darkened in front and on sides; scutum reddish brown; scutellum and postnotum dark brown, sparsely pruinose. Pleura black. Halteres weakly suffused with dusky, the base of stem restrictedly paler. Legs with the coxæ brownish black; trochanters obscure yellow, the tips narrowly darkened; femora yellow, with a narrow and very indistinct darker ring just before the tip; remainder of legs yellow; setæ of legs very long and conspicuous. Wings (Plate 1, fig. 18) much broader in male than in female, in the former widest opposite the termination of vein 2d A; ground color pale yellow, the basal cells slightly washed with dusky; a heavy dark brown pattern that is chiefly confined to the vicinity of the veins, the interspaces being immaculate; the chief markings are as follows: Postarcular; origin of Rs; along cord and centering about the supernumerary crossvein in cell R_3, these markings narrowly bordered by yellow and subtended

[8] Tidj. voor Ent. 51 (1913) pl. 17, fig. 16.

on either side by smaller spots; outer end of cell 1st M_2 and fork of M_{1+2} restrictedly darkened; a series of small subterminal spots in cells R_4 to 1st A, respectively, placed just cephalad of the vein and slightly back from the margin, the vein beyond this point more heavily darkened to the wing border; extreme axilla weakly darkened; veins pale, darker in the clouded areas. Venation: Supernumerary crossvein in cell R_3 oblique, placed at near two-thirds the length of cell; cell M_1 shallow, subequal to its petiole; cell 1st M_2 subrectangular, a little widened outwardly; m-cu about one-half its length beyond fork of M; vein 2d A bent rather strongly to border, simple in both sexes.

Abdomen black, the hypopygium more brightened. Male hypopygium (Plate 2, fig. 32) with the outer dististyle, *od*, nearly straight, unequally bidentate at tip, the terminal spine much stouter and more strongly curved than the outer subapical one.

Habitat.—Assam (Khasi Hills).

Holotype, male, Cherrapunji, altitude 4,000 to 5,000 feet, August, 1935, at light (*Sircar*). Allotopotype, female. Paratopotypes, several females.

The nearest relative of the present fly would appear to be *Limnophila* (*Dicranophragma*) *venustipennis* Alexander (*pulchripennis* Brunetti, preoccupied), of the eastern Himalayas. The present species is distinguished by the simple 2d anal vein of both sexes and the nature of the wing pattern, especially the geminate smaller spots subtending the larger dark areas along the cord and in the outer radial field. It seems virtually certain that Brunetti had two species confused in his original description. The true *venustipennis* is discussed in some detail below.

LIMNOPHILA (DICRANOPHRAGMA) VENUSTIPENNIS Alexander.

Dicranophragma pulchripennis BRUNETTI, Fauna Brit. India, Dip. Nematocera (1912) 524 (preoccupied in *Limnophila*).

Limnophila (*Dicranophragma*) *venustipennis* ALEXANDER, Insec. Inscit. Menst. 9 (1921) 180.

Several females that I am referring to this species are from Cherrapunji, Khasi Hills, Assam, altitude 4,000 to 5,000 feet, taken at light, August, 1935, by Mr. S. Sircar. The wings of the female are much narrower than in the males, while the 2d anal vein is simple. In the males of the type series of *pulchripennis* vein 2d A is forked near its outer end, as described by Edwards [9] and shown by a paratypical specimen in my collection. The proximal spur of this fork is surrounded by the most basal

[9] Rec. Indian Mus. 26 (1924) 303.

of the marginal darkened areas of the wing. Brunetti describes the thorax as being dark-colored, but the ground color is dark brown, the surface chiefly covered by more reddish brown stripes.

ERIOPTERINI

TRENTEPOHLIA (MONGOMA) SUBTENERA sp. nov. Plate 1, fig. 19.

Allied to *tenera;* general coloration of mesonotum almost uniformly dark brown, the scutellum clear yellow; femoral tips and tibial bases narrowly but conspicuously whitened; tibial tips broadly and conspicuously snowy white, the amount including approximately the distal fourth of the segment; tarsi snowy white; wings pale gray; veins R_{1+2}, R_2, and R_{3+4} subequal; inner end of cell R_5 lying a little more distad than that of cell M_3.

Female.—Length, about 8 millimeters; wing, 6.3.

Rostrum obscure yellow; palpi black. Antennæ black throughout; flagellar segments oval, the outer two segments shorter; verticils shorter than the segments and only a little more conspicuous than the normal pubescence. Head dark gray; anterior vertex reduced to a linear strip.

Pronotum above dark brown. Mesonotal præscutum and scutum almost uniformly dark brown, the median area of the latter a little paler; scutellum clear light yellow, the parascutella slightly darker; postnotum yellowish brown. Pleura with the dorsal and anterior sclerites infuscated, the posterior portions adjoining the wing root more yellow. Halteres dusky. Legs with the coxæ brownish yellow, the fore coxæ a trifle darker; trochanters yellow; femora dark brown, the tips rather narrowly but conspicuously white, the amount subequal on all legs and involving approximately one-ninth of the segment; tibiæ dark brown, the bases narrowly but conspicuously white, in degree about one-half as extensive as the femoral tips, passing gradually into the dark ground color; tibial tips broadly, conspicuously, and abruptly snowy white, including approximately one-fourth the total length of the segment; tarsi snowy white, the terminal segment weakly darkened; tips of posterior tibiæ very slightly enlarged and with the snowy-white vestiture more erect and conspicuous; posterior femora with about ten small spines in a linear row near base. Wings (Plate 1, fig. 19) relatively narrow, uniformly pale gray, cell Sc a trifle darker; veins pale brown. A scattered series of about eight trichia on vein R_5. Venation: Sc_1 ending just before the proximal or cephalic end of R_2; Rs a little longer than the basal section of R_5 and about in alignment with it; R_{2+3+4} long, gently sinuous; R_{1+2}, R_2, and R_{3+4} subequal; R_3 oblique; cell

1st M_2 gradually widened outwardly; inner end of cell R_5 lying a trifle more distad than that of cell M_3; m-cu close to fork of M; apical fusion of veins Cu_1 and 1st A relatively extensive, longer than the basal section of M_{1+2}.

Abdominal tergites dark brown, the basal segments a little paler; sternites obscure yellow to brownish yellow.

Habitat.—Assam (Khasi Hills).

Holotype, female, Cherrapunji, altitude 4,000 to 5,000 feet, August, 1935, at light (*Sircar*).

By all keys to the Oriental species of *Trentepohlia* the present fly runs to *Trentepohlia* (*Mongoma*) *tenera* (Osten Sacken), from which it differs in the coloration of the legs and the venation, especially the length of veins R_{3+4}, basal section of M_3, and apical fusion of Cu_1 and 1st A. Brunetti placed his species *pallidiventris* [10] as a synonym of *tenera*, but this is evidently an error. The species has the femora uniformly darkened beyond the base and the tibiæ whitened only at the tips.

TRENTEPOHLIA (MONGOMA) WALSHIANA sp. nov. Plate 1, fig. 20.

Thorax entirely orange, immaculate; antennæ black throughout; head gray, the posterior portion of vertex and the occiput paling to brown; halteres pale, the knobs light yellow; legs brownish black, the tips of tibiæ and the tarsi paling to yellow; wings whitish subhyaline, the prearcular and costal fields clear light yellow; a restricted dark pattern, including the wing tip; abdomen black, the segments restrictedly variegated by yellow.

Female.—Length, about 10 to 11 millimeters; wing, 9 to 10.

Rostrum dark brown to black; palpi black. Antennæ with scape and pedicel dark brown to black; flagellum black; flagellar segments cylindrical, relatively elongate. Front and anterior vertex light gray, the posterior vertex dark gray in front, paling to brown behind and on the occiput; anterior vertex reduced to a narrow strip, its posterior portion strongly carinate, the ridge continued caudad onto the posterior vertex.

Cervical sclerites light brown. Pronotum and mesonotum uniformly bright orange, the pleura a trifle more yellow. Halteres obscure brownish yellow, the base of stem narrowly yellow, the apex of knob clear light yellow. Legs with the coxæ and trochanters yellow; femora dark brown to brownish black, the extreme bases vaguely brightened; tibiæ pale brown to brownish yellow, becoming brighter at outer ends, the forepair more ex-

[10] Fauna Brit. India Dip. Nematocera (1912) 481; Rec. Indian Mus. 15 (1918) 312.

tensively brightened; tarsi light brownish yellow; femora with about four to twelve small erect spines, fewest on posterior femora. Wings (Plate 1, fig. 20) whitish subhyaline, the prearcular region and cells C and Sc clear light yellow; stigmal area small and restricted, triangular in outline, brownish yellow; wing tip narrowly infuscated, including cells R_3 to 2d M_2; veins R_2, cord, and Cu narrowly seamed with brown; veins brown, a little darker in the clouded areas, clear yellow in the flavous portions. Venation: R_2 a short distance before fork of R_{3+4}, its cephalic or proximal end faint to ill-defined in the stigmal area; basal section of M_3 slightly angulated; m-cu close to or shortly before fork of M; apical fusion of Cu_1 and 1st A punctiform.

Abdomen chiefly black, with faint bluish reflections, the dorsopleural region pale; lateral margins of tergites and basal lateral spots on sternites restrictedly yellow; in cases the sternal pale spots are more extensive, forming nearly complete crossbands on the basal rings of the segments. Ovipositor and genital segment deep yellow.

Habitat.—Sumatra (south).

Holotype, female, Boekit Jtam, Benkoelen, altitude 1,000 to 2,000 feet, June 11 to 15, 1935 (*Walsh*). Paratopotype, sex?

I take great pleasure in naming this beautiful crane fly in honor of the collector, Mrs. M. E. Walsh. The nearest described species is *Trentepohlia* (*Mongoma*) *auricosta* Alexander (western Java), which differs conspicuously in the coloration of the body, and the details of pattern of the legs and wings.

TRENTEPOHLIA (MONGOMA) EPHIPPIATA sp. nov. Plate 1, fig. 21.

General coloration of thorax black, the lateral and humeral portions of præscutum yellow; halteres brownish black; femora and tibiæ brownish black, the tips of the latter and the tarsi paling to yellow; wings whitish subhyaline, the prearcular and costal regions not conspicuously brightened; a weak darkened pattern, including the wing tip, stigma, and seams along vein Cu and origin of Rs; abdomen black, the basal rings of the intermediate sternites narrowly obscure yellow.

Female.—Length, excluding head, about 8 millimeters; wing, 7.4.

Head broken.

Cervical sclerites blackened. Pronotum brownish black above, obscure yellow basally on sides. Mesonotal præscutum obscure yellow on humeral and lateral portions, the entire disk covered by three confluent brownish black stripes that cross the suture

and include the scutal lobes; scutellum and postnotum brownish black. Pleura brownish black, the dorsopleural membrane and meral region a little paler. Halteres brownish black, the base of stem narrowly yellow. Legs with the fore and middle coxæ black, the posterior coxæ and all trochanters obscure yellow; femora brownish black, the extreme bases restrictedly brightened; tibiæ black, the distal ends paling to obscure yellow or brownish yellow; armature of legs including a series of four long erect setæ on distal fourth of posterior tibiæ. Wings (Plate 1, fig. 21) whitish subhyaline, including the prearcular region and basal half of costal field; outer portions of cells C and Sc a little more yellowish; stigma conspicuous, dark brown; wing tip weakly and rather narrowly infuscated; narrow but conspicuous brown seams along vein Cu and at origin of Rs, the remainder of cord very insensibly darkened; veins brown, paler in the costal and prearcular fields. Venation: R_2 about one-third its length before the fork of R_{3+4}; m-cu close to fork of M; inner end of cell M_3 a little more basad than that of cell R_5; apical fusion of veins Cu_1 and 1st A punctiform.

Abdomen black, the pleural membrane paler; basal rings of intermediate sternites narrowly obscure yellow. Ovipositor and genital segment yellow.

Habitat.—Sumatra (south).

Holotype, female, Tandjong Sakti, Benkoelen, altitude 1,650 to 2,000 feet, June 11 to 20, 1935 (*Walsh*).

Trentepohlia (*Mongoma*) *ephippiata* is allied to species such as *T.* (*M.*) *auricosta* Alexander, *T.* (*M.*) *flavicollis* Edwards, *T.* (*M.*) *hainanica* Alexander, and *T.* (*M.*) *walshiana* sp. nov., differing conspicuously in the coloration of the body. The blackened discal saddle of the mesonotal præscutum is distinctive.

TRENTEPOHLIA (TRENTEPOHLIA) STREPENS sp. nov. Plate 1, fig. 22.

Size very large; legs long and powerful; general coloration ferruginous yellow, the thorax unmarked; head gray, the vertex strongly carinate; legs yellow, the femoral tips, tibial bases, and tibial tips conspicuously blackened; wings pale yellow, the costal and outer radial fields more saturated yellow; restricted dark seams on veins R_3, basal section of M_{1+2}, m-cu, and fork of $R_5 + M_{1+2}$; abdomen yellow, the subterminal segments slightly infuscated.

Male.—Length, about 8 millimeters; wing, 7. Posterior leg, femur, 12; tibia, 12.5; tarsus, 8.

Rostrum obscure yellow; palpi brownish black. Antennæ brownish black, the scape a little brightened; flagellar segments

cylindrical, with dense dark pubescence. Head gray; anterior vertex narrow, the carina conspicuous.

Cervical sclerites obscure yellow. Thorax entirely ferruginous-yellow, the surface somewhat polished. Halteres yellow throughout. Legs with the coxæ and trochanters yellow; femora yellow, the tips rather broadly and very conspicuously blackened; tibiæ obscure yellow, the bases narrowly darkened, the tips broadly blackened; tarsi brownish black; legs unusually long and powerful, as shown by the measurements given above; femora with scattered erect setæ over the entire length. Wings (Plate 1, fig. 22) pale yellow, the costal and outer radial field more saturated yellow; a restricted dark pattern, including a narrow brown seam on vein R_3 and somewhat darker seams on posterior cord and fork of R_5+M_{1+2}; veins yellow, darkened in the clouded areas. Venation: m-cu shortly before fork of M; distal section of Cu_1 strongly arcuated, its apical fusion with 1st A slight.

Abdomen yellow, the subterminal segments slightly infuscated.

Habitat.—Sumatra (south).

Holotype, male, Tandjong Sakti, Benkoelen, altitude 1,650 to 2,000 feet, June 21 to 30, 1935 (*Walsh*).

Trentepohlia (*Trentepohlia*) *strepens* is the largest species of the subgenus so far made known, as is well shown by the leg measurements given above. It is allied to *T.* (*T.*) *holoxantha* Alexander and *T.* (*T.*) *mcgregori* Alexander, especially to the latter, differing especially in the major size and in the distinctive pattern of the wings.

MOLOPHILUS KHASICUS sp. nov. Plate 1, fig. 23; Plate 2, fig. 33.

Belongs to the *gracilis* group and subgroup; general coloration brown; antennæ (male) short; wings brownish yellow, the macrotrichia dark brown; abdomen dark brown, the hypopygium more yellowish; male hypopygium with all three lobes of basistyle obtuse at tips, with setæ throughout their lengths; three dististyles, all simple rods that are very markedly sinuous, the tips acute or subacute; intermediate and inner styles with spinulæ on distal third.

Male.—Length, about 3.8 millimeters; wing, 4.4.

Rostrum dark brown; palpi black. Antennæ (male) short, if bent backward ending far before the wing root; scape and pedicel light yellow, flagellum dark brown, flagellar segments short-cylindrical, with long conspicuous verticils. Head dark brownish gray.

Pronotum brownish black. Mesonotal præscutum dark brown, with a faint reddish cast, somewhat darker colored laterally and on extreme cephalic portion; scutum and scutellum brown; mediotergite darker colored. Pleura dark brown, with a vague paler longitudinal stripe across the dorsal sternopleurite and ventral pteropleurite, beginning behind the posterior coxæ. Halteres pale yellow throughout. Legs with the coxæ and trochanters brownish yellow; remainder of legs brownish yellow, with dark-colored setæ that obscure the ground; outer tarsal segments more uniformly dark brown. Wings (Plate 1, fig. 23) with a strong brownish yellow tinge, the veins darker brown; macrotrichia dark brown; costal fringe long and dense. Venation: R_2 about opposite r-m; m-cu about one-half the petiole of cell M_3; vein 2d A ending opposite caudal end of m-cu.

Abdomen dark brown, the large hypopygium more yellowish. Male hypopygium (Plate 2, fig. 33) with all three lobes of basistyle, *b*, simple and nonspinous, with setæ to their tips. Three dististyles, the outer, *od*, a strongly sinuous, slender rod, its distal third straight; intermediate style, *md*, a simple rod, its distal third very strongly bent and thence narrowed into a spine, this portion of style bearing a linear row of slender teeth; inner style, *id*, a strongly curved simple rod, its distal third with a series of five or six strong spinules. Phallosomic plate oval in outline.

Habitat.—Assam (Khasi Hills).

Holotype, male, Cherrapunji, altitude 4,000 to 5,000 feet, August, 1935, at light (*Sircar*).

The *Molophilus* fauna of the Himalayan region is still very poorly known. From the few species hitherto described the present fly is readily told by the unusually large and complicated male hypopygium, in conjunction with the short antennæ of the male sex. The most generally similar species seems to be *Molophilus genitalis* (Brunetti), which has the male hypopygium of entirely different conformation.[11]

TOXORHINA (CERATOCHEILUS) MESORHYNCHA sp. nov. Plate 1, fig. 24; Plate 2, fig. 34.

General coloration of mesonotal præscutum dark brown, the lateral margins gray; rostrum much shorter than the wing; anterior vertex wide; legs brownish black; wings pale gray, veins light brown; no macrotrichia on Rs or its anterior branch; abdomen brownish black; male hypopygium with the dististyle pro-

[11] Edwards, F. W., Rec. Indian Mus. 26 (1924) 300.

duced into a long, straight, apical point, on outer margin at near one-third the length bearing a pale fleshy spine.

Male.—Length, excluding rostrum, about 6 millimeters; wing, 5.3; rostrum, 3.5.

Rostrum much shorter than the wing, black throughout. Antennæ black, the first segment a little pruinose but not at all brightened. Head brown, the front, anterior vertex, and broad posterior orbits light gray; anterior vertex unusually broad, approximately one-third the width of the head at this point, or equal to the visible diameter of either eye.

Pronotum dark brown. Mesonotal præscutum with the dorsum largely occupied by three, confluent, dark brown stripes that restrict the dull gray ground color to the humeral and lateral portions; scutal lobes dark brown, the median area more grayish; scutellum and postnotum gray. Pleura bicolorous, the dorsopleural membrane and dorsal sclerites much darker than the sternopleurite and meral areas, the dark color continued caudad beneath the wing root and including the lateral and caudal portions of the mediotergite. Halteres obscure yellow. Legs with the coxæ gray; trochanters yellowish brown; remainder of legs brownish black. Wings (Plate 1, fig. 24) with a uniform, pale gray tinge; veins light brown. No macrotrichia on Rs or its anterior branch; posterior branch with a series of about twenty on distal section of vein R_5; seven or eight trichia on outer section of vein M_{1+2}. Venation: Sc_1 ending just beyond origin of Rs, the latter a little more than one-half as long as its gently sinuous anterior branch; m-cu close to fork of M.

Abdomen brownish black, the hypopygium very little brighter. Male hypopygium (Plate 2, fig. 34) with the basistyle, *b*, provided with a blunt lobe on mesal face near base, this lobe tipped with numerous long coarse setæ. A single, entirely pale dististyle, *d*, produced into a long straight apical point; on outer margin at near the basal third with a slender, gently curved, fleshy spine. Arms of ædeagus, *a*, relatively short.

Habitat.—Assam (Khasi Hills).

Holotype, male, Cherrapunji, altitude 4,000 to 5,000 feet, August, 1935, at light (*Sircar*).

Toxorhina (*Ceratocheilus*) *mesorhyncha* is readily told from *T.* (*C.*) *brevifrons* (Brunetti), likewise from Assam, by the wide anterior vertex, short rostrum, uniformly darkened antennæ, and darkened abdominal sternites. I have provided below a redescription of the holotype specimen of *brevifrons*.

TOXORHINA (CERATOCHEILUS) BREVIFRONS (Brunetti).

Conithorax brevifrons BRUNETTI, Rec. Indian Mus. 15 (1918) 300.

The holotype, a female, was taken above Tura, Garo Hills, Assam, altitude 3,500 to 3,900 feet, August, 1917, by Dr. Stanley Kemp. I am indebted to Dr. H. Singh Pruthi for the opportunity to reëxamine this specimen and have provided additional notes concerning certain critical points.

Female.—Length, excluding rostrum, about 7 millimeters; wing, 6.3; rostrum, about 8.

Rostrum elongate, exceeding the remainder of body, black throughout. Antennæ black, the small scape obscure yellow. Anterior vertex very narrow, only a little wider than the antennal pedicel, the sides concave; head beneath a little wider than on the vertex. Head brownish gray, the anterior vertex and orbits clear light gray.

Mesonotum dark brown, the humeral region and narrow lateral margins of the præscutum brighter; median region of the scutum paler than the lobes. Pleura dark dorsally, the dorsal portion of the sternopleurite more brownish yellow. Halteres relatively short, dusky. Legs dark brown, the femoral bases restrictedly paler. Wings with a faint brown tinge; veins dark brown. Macrotrichia of veins relatively abundant, there being a series of about five on Rs; apparently lacking on the distal section of M_4; a single puncture of R_{2+3+4} shortly beyond origin; a series of at least thirty trichia on distal section of R_5; about eight on basal section of R_5. Venation: Sc_1 ending about opposite two-fifths the length of Rs, Sc_2 before the origin of Rs; Rs and the two sections of R_5 in sinuous alignment; R_{2+3+4} relatively long, ending beyond the level of r-m; cell 1st M_2 closed, relatively large; m-cu just beyond the fork of M; approximation of veins Cu and 1st A relatively slight.

Abdominal tergites dark brown, the sternites yellowish brown; genital segment obscure brownish yellow. Ovipositor with the tergal valves very long and slender, the basal three-fourths or more straight, the apex gently upcurved; external valves more compressed, horn-colored.

The sides of the anterior vertex are strongly concave, not convex, as indicated by Brunetti. Two of the figures given by Brunetti (loc. cit., pl. 8, figs. 12, 13) as representing *Teucholabis angusticapitis* Brunetti pertain to a species of *Ceratocheilus*, presumably *C. latifrons* (Brunetti).

ILLUSTRATIONS

[*a*, Ædeagus; *b*, basistyle; *d*, dististyle; *g*, gonapophysis; *i*, interbase; *id*, inner dististyle; *ig*, inner gonapophysis; *md*, middle dististyle; *od*, outer dististyle; *og*, outer gonapophysis; *s*, sternite; *t*, tergite; *vd*, ventral dististyle.]

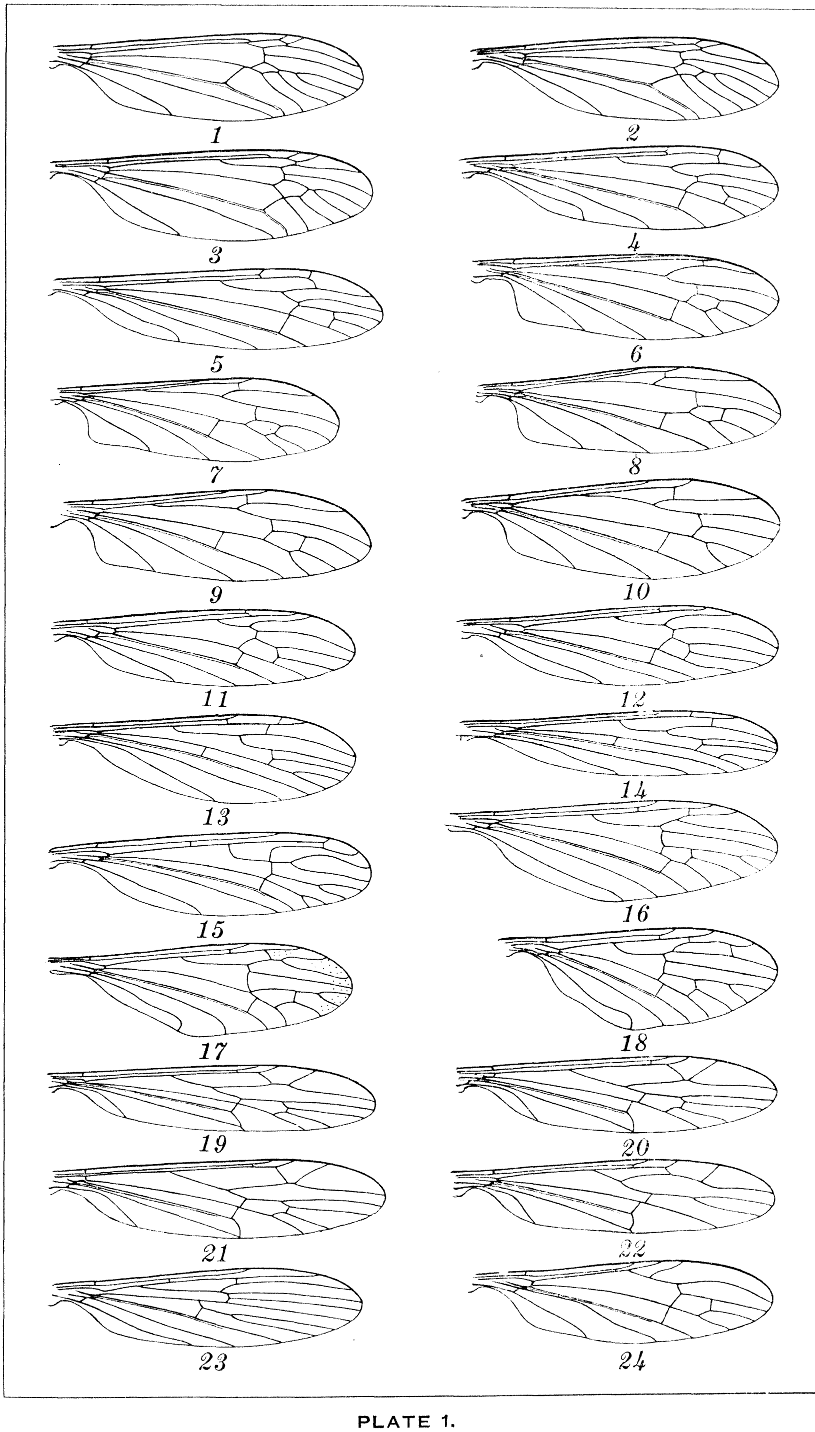


PLATE 1.

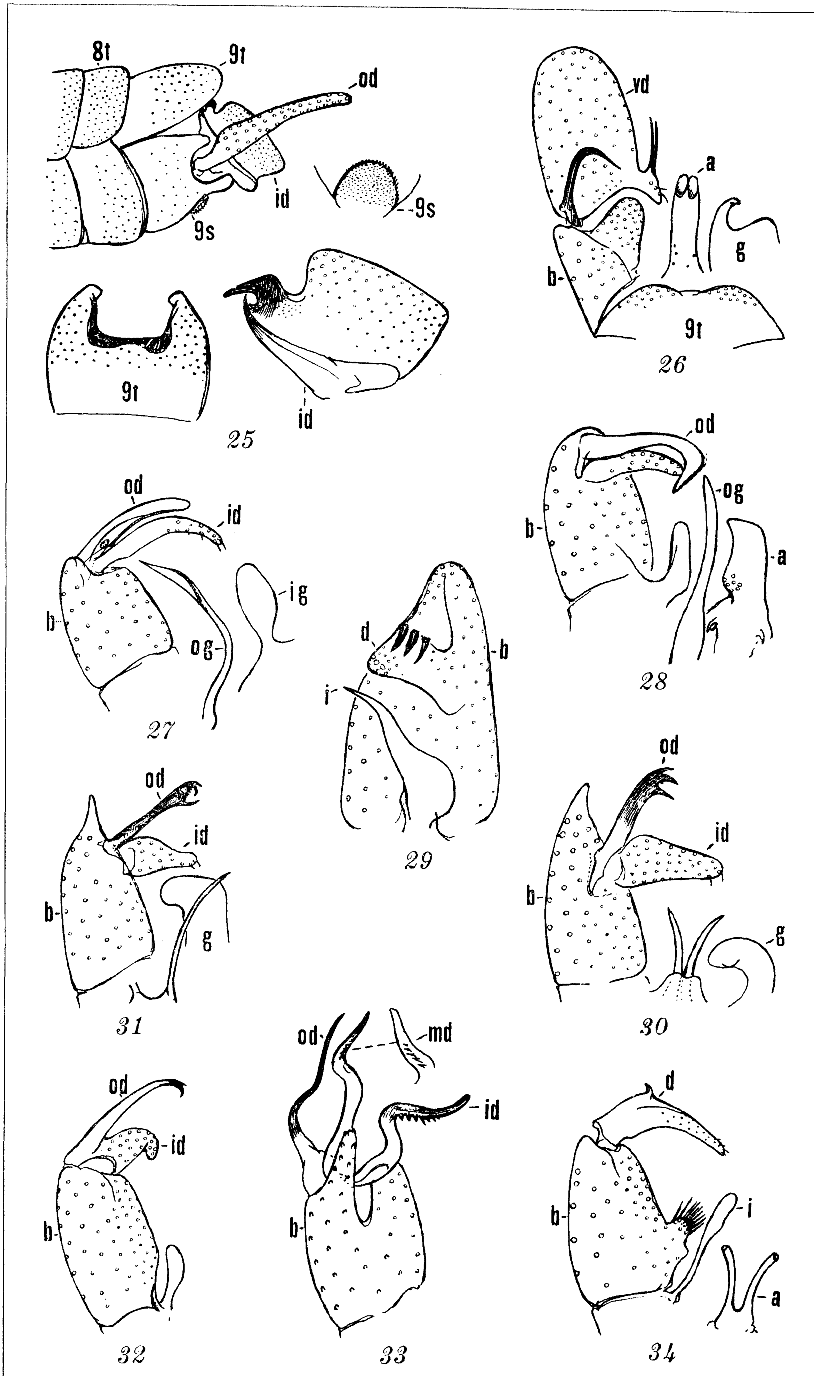

8t
9t
od
id
9s
9s
9t
id
25
vd
a
g
b
9t
26
od
id
ig
b
og
27
od
og
b
a
28
d
b
i
29
od
id
b
g
31
od
id
b
g
30
od
md
id
b
33
od
id
b
32
d
i
b
a
34

PLATE 2.

NOTES ON PHILIPPINE MOSQUITOES, VI

THE PUPAL CHARACTERS OF ANOPHELINES OF THE SUBGENUS MYZOMYIA

By F. E. BAISAS

Of the Bureau of Health, Manila

TWENTY-FIVE PLATES

The material upon which this paper is based was collected mainly in Luzon. *Anopheles parangensis* and one *A. indefinitus* found breeding with *parangensis* are from Davao, Mindanao; and two *A. minimus* var. *flavirostris* are from Itbayat Islands, Batanes.[1]

Among Philippine *Anopheles* some closely related varieties and species are easily separated in the egg stage (as the local varieties of *sinensis*); others are very difficult if not impossible to differentiate by the characters of the eggs, but are readily separated by the characters of the larvæ (such as *Anopheles hyrcanus* var. *nigerrimus* and *A. hyrcanus* var. *lesteri*); while still others, which are very much alike in the larval stage, possess marked differences in the pupæ (as *A. hyrcanus* var. *pseudosinensis* and *A. hyrcanus* var. *lesteri;* or *A. leucosphyrus* and *A. leucosphyrus* var. *balabacensis*). It would seem, therefore, that the conclusions of Hackett (1934, 1935) and other European workers with regard to the reliability of egg characters (because they are genotypic in nature) in the differential diagnosis of the varieties of *maculipennis,* and the claim they make that morphological differences in the larvæ and adults are unstable (therefore, unreliable) because they can be so modified by en-

[1] To the many persons and entities mentioned in the previous parts of these Notes, I have to add Major G. C. Dunham, formerly Health Adviser to the Governor General (now High Commissioner), who gave to the malaria section of the Bureau of Health specimens of *A. minimus* var. *flavirostris,* which the Major himself collected in the Batanes; and Mr. Andres Nono, civilian field director of the malaria control work at Iwahig and Davao Penal Colonies, who kindly gave me specimens of *parangensis* and other rare species from Palawan and Mindanao Islands.

vironment as to obscure the genetic differences, cannot be completely applied to the classification of Philippine species of *Anopheles*. It seems that a consideration of the characters in all stages, whenever possible, should be the basis of classification.

Unlike the species of the subgenus *Anopheles*, which can be readily separated in the pupal stage, many of the forms of the subgenus *Myzomyia* do not possess marked specific characters. The groups, however, are quite easily separable, as shown in the following key:

Key to groups of the subgenus Myzomyia, based on pupal characters.

1. Paddle hair short, straight; *A*–VII blunt, at most 0.4676 mm long, usually much shorter .... Group *Neomyzomyia*.
   Paddle hair long, curved; *A*–VII distinctly pointed, at least 0.5845 mm long, usually much longer .... 2.
2. Hair *C*–II branched more than 10.......... Group *Myzomyia*.
   Hair *C*–II branched less than 10.......... 3.
3. *A*–VI and *A*–VII more than half the lengths of segments VII and VIII, respectively (at least 0.6 mm long, usually much longer); *K*–I usually simple, sometimes split into 2.......... Group *Pseudomyzomyia*.
   A–VI and *A*–VII half or less the lengths of the succeeding segments, respectively (at most less than 0.6 mm long, usually much shorter); *K*–I usually 5-branched, range 3 to 9.......... Group *Neocellia*.

In Table 1 the variations in the branching of the different hairs are shown.

The scheme used in designating the hairs and other parts of the pupa is shown in Plates 1 and 2. This is adapted from Senevet (1930–1932) as modified by Christophers (1933). Reference to the metathorax is by the capital letter "M" and to the abdominal segments by Roman numerals. Hairs on the metathorax and abdominal segment I may be referred to without the "M" or the "I" as *R*, *T*, etc., or they may be written *R*–M, *T*–I, etc. The spines and other hairs are referred to with the corresponding segments as *A*–II, *B*–V, etc., but *C'*–VI may be written merely *C'*, because this hair is present only on segment VI.

In the subgenus *Myzomyia* hair *S* is invariably branched and is the shortest and most internal of the three hairs situated at the anterolateral border of abdominal segment I. It is posterior to *T* but anterior to *U* in position. Senevet's conventional illustrations for *subpictus* Grassi and *vagus* Dönitz (1931, p. 40 and p. 74, respectively) are somewhat misleading, especially because his corresponding descriptions (p. 41 and p. 75, respec-

tively), "*S*, moyenne, 3–4 branches" for *subpictus,* and "*S* . . ., tres longue et simple" for *vagus,* do not agree with his illustrations. In a subsequent paper (1932) the character of *S* for *vagus* which Senevet presents is more in agreement with that for *vagus* var. *limosus* of the Philippines, although the unusual simple *S* and 4-branched *T* of his specimen No. 4 have not been duplicated by any of the many specimens I have examined of the local species of the group *Pseudomyzomyia.*

For the local species of the subgenus *Myzomyia* the characters of *A, B,* and *C* are of specific and group values in many cases; in some very closely allied species *A* alone indicates differences between the forms. Branching of *A,* particularly *A*–VII, is common to all species except one in the group *Neomyzomyia;* while splitting into two of *A*–VII in group *Myzomyia* (especially in *mangyanus*) occurs with such frequency as to be considered a normal, though less common, peculiarity; but in the other groups—*Neocellia* and *Pseudomyzomyia*—this happens very rarely and may therefore be taken as an abnormality. Duplication of a spine sometimes occurs. Normally there is a progressive increase in the length of the spines from the anterior to the posterior segments, the longest being *A*–VII. Sometimes, however, *A*–VI and, more rarely, *A*–V are as long as or even longer than *A*–VII. Again, a spine that is ordinarily short may attain a length entirely beyond its normal proportions, or vice versa. But such abnormalities affect, so far as I have noted, only the spine of one side of a segment. Group *Pseudomyzomyia* possesses the longest spines, as can be seen in Table 2.

Of the parts of the paddle, the denticles (their relative sizes, and the extent of the external border they occupy), the presence or absence of accessory denticles on the anterolateral border of the paddle, and the length of the paddle hair are useful in differential diagnosis.

GROUP NEOMYZOMYIA

(Excluding *kolambuganensis* of which we have no pupal material.)

As mentioned by Christophers (1933), and others, this group differs greatly from the other groups in the subgenus *Myzomyia,* and is similar to the subgenus *Anopheles* in having short paddle hair, and short, blunt spines.

TABLE 1.—*Variations in the branching of pupal hairs in the subgenus Myzomyia.*

Part.	Hairs.	Group *Myzomyia*.						Group *Neomyzomyia* (part).			
		Anopheles filipinæ.		*Anopheles flavirostris.*		*Anopheles mangyanus.*		*Anopheles kochi.*		*Anopheles tessellatus.*	
		Range.	Usual.	Range.	Usual.	Range.	Usual.	Range.	Usual.	Range.	Usual.
Metathorax	*R*	4– 6	5	4– 8	5	4– 9	5	2– 3	2	3– 5	3
Do	*P*	2– 6	4	3– 7	5	3– 6	4	1– 2	2	2– 4	3
Do	*O*	1– 4	2	2– 5	4	2– 5	3	2– 3	2	1– 2	1
Abdominal segment I	*H*	1– 2	1	1– 3	2	1– 3	2	1– 4	2	1– 1	1
Do	*K*	3– 8	5	6–11	7	3– 8	6	3– 4	3	5– 6	5
Do	*L*	4–12	8	7–11	8	4–10	5	4– 5	4	4– 5	5
Do	*M*	1– 8	2	1– 3	3	1– 4	2	2– 3	3	3– 5	4
Do	*S*	4– 8	5	6–10	7	3– 9	5	3– 5	3	4– 9	5
Do	*T*	1– 3	2	2– 5	3	1– 4	3	2– 3	2	4– 7	5
Do	*U*	3– 8	4	3– 6	4	2– 5	3	1– 1	1	1– 2	1
Abdominal segment II	*C*	10–18	14	16–33	21	12–25	15	9–14	13	9–16	12
Do	1	1– 2	1	1– 2	1	1– 4	2	1– 2	2	3– 5	4
Do	1	3– 9	5	5–10	8	4– 9	6	2– 5	3	3– 6	5
Do	2	3– 8	5	5– 8	6	3– 7	5	2– 4	2	4– 6	5
Do	2	2– 8	6	6–14	7	3– 9	5	3– 4	3	3– 5	3
Do	3	2– 5	3	5– 9	6	3– 8	5	1– 2	2	1– 3	2
Do	4	4– 8	6	6–13	10	3– 8	6	4– 6	5	5–12	6
Do	5	1– 1	1	1– 1	1	1– 1	1	1– 1	1	1– 1	1
Abdominal segment III	*B*	7–15	11	10–22	14	8–18	11	6–10	10	9–12	11
Do	*C*	8–17	10	8–18	13	11–20	16	5– 7	6	11–13	11
Do	1	3– 8	5	3– 9	5	2– 9	5	1– 2	2	4– 6	5
Do	2	3– 9	5	4– 9	7	2– 7	4	2– 4	4	3– 5	4
Do	3	2– 6	4	4– 9	7	4– 9	6	1– 2	2	1– 2	2
Do	4	4–10	8	7–14	10	5–10	8	3– 4	4	6– 8	7
Do	5	1– 1	1	1– 1	1	1– 1	1	1– 1	1	1– 1	1

Abdominal segment IV	*B*	6–13	7	8–13	10	6–11	9	6– 9	7	8–14	12
Do	*C*	6–13	8	5–13	8	8–18	11	3– 4	3	8–12	10
Do	1	4– 6	5	4– 7	5	2– 6	4	1– 1	1	2– 5	4
Do	2	2– 6	3	2– 5	3	1– 4	2	2– 4	3	3– 5	4
Do	3	4–10	6	4– 9	7	4– 8	7	4– 7	6	4– 7	5
Do	4	5–10	7	5–10	8	3– 9	7	3– 3	3	5– 7	5
Do	5	1– 1	1	1– 1	1	1– 1	1	1– 1	1	1– 1	1
Abdominal segment V	*B*	3–11	8	7–11	9	4– 9	7	3– 5	5	8–12	11
Do	*C*	2– 7	3	2– 6	3	1– 7	3	2– 3	2	6– 9	6
Do	1	2– 6	3	3– 6	4	2– 4	3	1– 1	1	3– 5	3
Do	2	2– 5	4	3– 6	5	1– 5	3	2– 3	3	2– 5	4
Do	3	2– 4	3	2– 5	3	2– 6	3	2– 2	2	2– 5	3
Do	4	3– 7	6	4–10	7	3– 7	5	3– 4	3	5– 7	5
Do	5	1– 1	1	1– 1	1	1– 2	1	1– 1	1	1– 1	1
Abdominal segment VI	*B*	3– 8	6	6–10	8	4– 9	5	3– 4	3	5–10	7
Do	*C*	2– 4	2	2– 4	3	1– 4	3	1– 1	1	5– 8	6
Do	*C′*	2– 4	3	2– 4	3	1– 4	3	1– 1	1	1– 3	2
Do	1	2– 4	2	2– 5	3	1– 4	2	1– 2	1	3– 5	3
Do	2	1– 3	2	2– 3	3	1– 3	2	2– 2	2	1– 5	3
Do	4	4– 7	5	4– 9	6	1– 4	3	2– 3	2	4– 7	5
Do	5	1– 1	1	1– 1	1	1– 1	1	1– 1	1	1– 1	1
Abdominal segment VII	*B*	3– 7	4	6– 9	7	4– 8	6	2– 3	3	6–10	10
Do	*C*	2– 3	3	1– 4	3	1– 5	3	1– 1	1	2– 4	3
Do	1	1– 5	2	2– 3	3	1– 3	1	1– 1	1	3– 4	3
Do	2	1– 4	2	1– 3	2	1– 3	1	2– 2	2	2– 3	3
Do	3	2– 4	3	3– 5	3	1– 6	3	2– 3	3	3– 6	4
Do	4	3– 6	5	4– 7	5	1– 4	2	1– 2	2	4– 8	6
Do	5	1– 1	1	1– 1	1	1– 1	1	1– 1	1	1– 1	1
Abdominal segment VIII	*A*	6–19	14	10–19	14	7–16	11	10–14	11	8–10	8
Do	*A′*	1– 4	3	2– 5	3	1– 4	3	2– 3	3	3– 4	4
Do	5	1– 1	1	1– 1	1	1– 1	1	1– 1	1	1– 1	1
Paddle	*p*	1– 1	1	1– 1	1	1– 1	1	1– 1	1	1– 1	1
Do	*ap*	3– 5	4	4– 7	5	2– 5	3	1– 2	2	2– 4	3

TABLE 1.—*Variation in the branching of pupal hairs in the subgenus Myzomyia*—Continued.

Part.	Hairs.	Group *Pseudomyzomyia*.											
		Anopheles indefinitus.				*Anopheles limosus.*		*Anopheles litoralis.*		*Anopheles ludlowi.*		*Anopheles parangensis.*	
		Fresh water.		Salt water.									
		Range.	Usual.	Range.	Usual.	Range.	Usual.	Range.	Usual.	Range.	Usual.	Range.	Usual.
Metathorax	*R*	2- 4	3	2- 3	3	2- 5	3	1- 3	2	1- 3	3	5- 8	7
Do	*P*	3- 5	3	2- 4	3	2- 5	3	3- 4	3	2- 4	3	3- 5	3
Do	*O*	1- 4	2	2- 5	3	2- 3	2	1- 6	3	1- 4	2	2- 4	2
Abdominal segment I	*H*	1- 4	2	1- 2	1	1- 2	1	1- 2	1	1- 2	1	1- 1	1
Do	*K*	4- 8	5	4- 7	5	3- 5	5	3- 7	4	3- 5	4	5- 9	7
Do	*L*	5-10	9	6- 9	7	5- 8	6	5- 8	6	5- 7	6	7-12	8
Do	*M*	1- 3	2	1- 2	2	3- 3	3	1- 3	2	1- 3	2	1- 1	1
Do	*S*	3- 8	6	3- 8	5	4- 7	5	2- 6	3	3- 6	5	6-10	8
Do	*T*	1- 1	1	1- 1	1	1- 1	1	1- 2	1	1- 2	2	1- 2	1
Do	*U*	1- 1	1	1- 1	1	1- 1	1	1- 2	1	1- 2	1	1- 1	1
Abdominal segment II	*C*	5- 9	7	4- 9	7	5- 7	7	3- 6	4	4- 8	6	7-10	9
Do	1	1- 1	1	1- 1	1	1- 1	1	1- 3	1	1- 3	2	1- 1	1
Do	1	4- 8	5	3- 7	4	5- 7	5	3- 6	4	4- 9	4	5- 8	6
Do	2	3- 6	5	3- 5	4	3- 5	4	1- 2	2	2- 4	3	4- 6	5
Do	2	4- 7	5	4- 6	5	5- 7	6	4- 7	5	4- 7	6	4- 7	5
Do	3	1- 4	3	2- 3	2	2- 4	3	1- 3	1	1- 5	3	3- 6	5
Do	4	5-12	7	5- 9	7	4- 7	6	3- 6	5	5- 8	5	5- 6	6
Do	5	1- 1	1	1- 1	1	1- 2	1	1- 1	1	1- 1	1	1- 1	1
Abdominal segment III	*B*	5- 8	6	4- 8	5	5- 7	7	3- 8	5	4- 9	5	5-11	8
Do	*C*	4- 7	5	3- 6	4	5- 8	6	2- 5	3	3- 7	4	5-11	9
Do	1	3- 7	5	3- 6	3	2- 3	2	1- 3	2	2- 3	2	3- 5	3
Do	2	4- 9	6	5- 9	6	4- 6	5	5- 8	6	4- 8	6	4- 7	5
Do	3	2- 4	3	1- 3	3	1- 3	3	2- 4	3	1- 4	3	2- 6	4
Do	4	5- 8	7	4- 8	7	5- 8	7	3- 5	4	3- 7	4	5- 7	6
Do	5	1- 1	1	1- 1	1	1- 1	1	1- 1	1	1- 2	1	1- 1	1

Abdominal segment IV	*B*	3- 7	5	3- 6	5	3- 6	5	3- 7	5	3- 6	5	5- 8	7
Do.	*C*	3- 6	4	3- 5	4	3- 5	3	1- 3	1	1- 2	1	6-10	7
Do.	1	2- 5	3	3- 4	3	1- 3	2	1- 2	1	1- 1	1	3- 5	4
Do.	2	3- 8	5	4- 8	6	4- 6	4	4- 7	6	3- 7	5	3- 6	6
Do.	3	4- 7	6	4- 6	5	5- 7	6	4- 7	5	3- 7	5	5- 8	7
Do.	4	4- 7	5	3- 7	6	3- 5	4	2- 5	3	2- 4	3	5- 7	6
Do.	5	1- 1	1	1- 1	1	1- 1	1	1- 1	1	1- 1	1	1- 1	1
Abdominal segment V	*B*	3- 5	4	3- 5	3	4- 5	5	1- 6	4	3- 5	4	4- 5	5
Do.	*C*	1- 1	1	1- 2	1	1- 2	1	1- 2	1	1- 1	1	1- 1	1
Do.	1	2- 5	3	2- 3	3	2- 3	2	1- 1	1	1- 1	1	3- 5	4
Do.	2	3- 6	4	2- 6	4	3- 5	4	3- 5	3	3- 6	5	4- 5	5
Do.	3	1- 3	2	1- 3	2	1- 4	3	1- 3	1	1- 3	2	1- 4	3
Do.	4	3- 7	5	3- 5	4	3- 5	4	1- 4	3	3- 4	3	4- 7	6
Do.	5	1- 1	1	1- 1	1	1- 1	1	1- 1	1	1- 1	1	1- 2	1
Abdominal segment VI	*B*	3- 5	3	3- 5	3	3- 6	5	2- 5	3	3- 6	4	3- 5	4
Do.	*C*	1- 1	1	1- 1	1	1- 2	1	1- 1	1	1- 1	1	1- 1	1
Do.	*C'*	2- 4	3	1- 4	3	1- 3	2	1- 3	2	1- 4	2	2- 3	3
Do.	1	2- 4	3	2- 3	2	2- 3	2	1- 1	1	1- 2	1	3- 5	4
Do.	2	1- 3	2	2- 3	2	1- 2	2	1- 1	1	1- 2	1	1- 4	3
Do.	4	3- 6	5	3- 5	4	3- 5	3	1- 3	2	2- 3	3	4- 6	5
Do.	5	1- 1	1	1- 1	1	1- 1	1	1- 1	1	1- 2	1	1- 1	1
Abdominal segment VII	*B*	2- 4	3	2- 5	3	4- 5	5	2- 6	3	3- 5	4	2- 5	3
Do.	*C*	1- 1	1	1- 1	1	1- 1	1	1- 1	1	1- 1	1	1- 1	1
Do.	1	2- 4	3	2- 4	2	2- 3	2	1- 3	2	1- 3	1	1- 4	3
Do.	2	1- 3	1	1- 2	1	1- 2	1	1- 2	1	1- 2	1	2- 3	3
Do.	3	2- 5	4	3- 5	3	3- 4	3	2- 4	3	2- 4	3	1- 5	4
Do.	4	3- 6	4	3- 4	4	3- 5	4	1- 3	2	1- 5	3	4- 7	4
Do.	5	1- 1	1	1- 1	1	1- 1	1	1- 1	1	1- 2	1	1- 1	1
Abdominal segment VIII	*A*	9-18	11	8-16	12	11-22	14	9-16	11	7-16	12	----------	10
Do.	*A'*	1- 3	2	1- 2	1	1- 2	2	1- 1	1	1- 2	1	3- 3	3
Do.	5	1- 1	1	1- 1	1	1- 1	1	1- 1	1	1- 1	1	1- 1	1
Paddle	*p*	1- 1	1	1- 1	1	1- 1	1	1- 1	1	1- 1	1	1- 1	1
Do.	*ap*	2- 4	3	2- 3	3	1- 2	2	1- 3	2	2- 3	2	3- 5	5

TABLE 2.—*Lengths of pupal spines in species of the subgenus Myzomyia.*

[Figures are fractions of a millimeter.]

Group and species.	A-II			A-III			A-IV		
	Range.	Average.	Com-monest.	Range.	Average.	Com-monest.	Range.	Average.	Com-monest.
Myzomyia									
Anopheles filipinæ	0.0334–0.0668	0.0526	0.0501	0.0668–0.1837	0.0980	0.0835	0.2505–0.5010	0.3976	0.3674
Anopheles minimus var. *flavirostris*	0.0501–0.0668	0.0626	0.0501	0.0668–0.1002	0.0935	0.0835	0.3507–0.4509	0.3974	0.4008
Anopheles mangyanus	0.0251–0.0835	0.0566	0.0668	0.1169–0.2672	0.1697	0.1336	0.5016–0.6847	0.6273	0.6179
Neocellia									
Anopheles annularis	0.0251–0.1002	0.0361	0.0334	0.0919–0.1670	0.1274	0.1336	0.1837–0.4008	0.2573	0.2338
Anopheles philippinensis	0.0334–0.0668	0.0439	0.0334	0.1062–0.1670	0.1258	0.1169	0.1670–0.3173	0.2041	0.1837
Anopheles karwari	0.0418–0.0501	0.0486	0.0501	0.0501–0.0835	0.0703	0.0668	0.0668–0.1336	0.0930	0.1002
Anopheles maculatus	0.0334–0.0835	0.0351	0.0334	0.0418–0.1062	0.0668	0.0585	0.2338–0.3517	0.3022	0.3340
Neomyzomyia									
Anopheles leucosphyrus	0.0251–0.0334	0.0317	0.0334	0.0334–0.0501	0.0443	0.0501	0.0501–0.1002	0.0718	0.0668
Anopheles l. var. *balabacensis*	0.0167–0.0668	0.0428	0.0501	0.0501–0.1002	0.0735	0.0668	0.1670–0.3340	0.2801	0.3006
Anopheles cristatus	0.0334–0.0501	0.0362	0.0334	0.0334–0.0835	0.0585	0.0668	0.0501–0.0919	0.0723	0.0835
Anopheles kochi	0.0334–0.0418	0.0384	0.0334	0.0334–0.0501	0.0397	0.0334	0.0501–0.0668	0.0585	0.0585
Anopheles tessellatus	0.0251–0.0501	0.0334	0.0334	0.0334–0.0668	0.0501	0.0501	0.0334–0.0835	0.0668	0.0668
Pseudomyzomyia									
Anopheles indefinitus, fresh water	0.0334–0.0918	0.0676	0.0668	0.1002–0.1837	0.1299	0.1336	0.1837–0.3340	0.2725	0.3173
Anopheles indefinitus, salt water	0.0334–0.0835	0.0548	0.0668	0.0835–0.2004	0.1271	0.1002	0.1169–0.2839	0.2098	0.2171
Anopheles limosus	0.0334–0.0501	0.0478	0.0501	0.0668–0.1169	0.0997	0.1002	0.1086–0.2004	0.1560	0.1336
Anopheles litoralis	0.0251–0.0501	0.0423	0.0501	0.0668–0.1169	0.0969	0.1002	0.1002–0.2505	0.1823	0.2004
Anopheles ludlowi	0.0251–0.0835	0.0631	0.0501	0.0835–0.2004	0.1481	0.1503	0.2338–0.4676	0.3186	0.3173
Anopheles parangensis	0.0334–0.0585	0.0434	0.0501	0.1002–0.1169	0.1119	0.1169	0.1670–0.2171	0.1962	0.2004

Group and species.	A-V			A-VI			A-VII		
	Range.	Average.	Commonest.	Range.	Average.	Commonest.	Range.	Average.	Commonest.
Myzomyia									
Anopheles filipinæ	0.3841–0.6179	0.5115	0.4843	0.5344–0.7849	0.6563	0.6179	0.5511–0.8016	0.6982	0.6847
Anopheles minimus var. *flavirostris*	0.5177–0.6513	0.5855	0.6012	0.5845–0.7682	0.6735	0.6680	0.6680–0.8183	0.7627	0.7575
Anopheles mangyanus	0.5845–0.8183	0.7047	0.7181	0.7014–0.9352	0.8165	0.8183	0.7014–0.9686	0.8579	0.8350
Neocellia									
Anopheles annularis	0.3340–0.5845	0.4399	0.4509	0.4008–0.6346	0.5165	0.5010	0.5010–0.6847	0.5716	0.5678
Anopheles philippinensis	0.4342–0.7515	0.5237	0.5177	0.5177–0.8547	0.6398	0.6346	0.6680–0.8851	0.7675	0.7682
Anopheles karwari	0.3841–0.7847	0.5384	0.5344	0.4843–0.7515	0.6099	0.5845	0.5177–0.7849	0.6480	0.6346
Anopheles maculatus	0.5678–0.6346	0.6075	0.6179	0.6179–0.7181	0.6530	0.6346	0.6513–0.7515	0.7036	0.7181
Neomyzomyia									
Anopheles leucosphyrus	0.2004–0.2672	0.2238	0.2171	0.2338–0.3340	0.2889	0.2839	0.3006–0.3674	0.3273	0.3170
Anopheles l. var. *balabacensis*	0.3340–0.4175	0.3724	0.3841	0.3674–0.4342	0.3904	0.3674	0.3170–0.4509	0.3818	0.3841
Anopheles cristatus	0.3173–0.4927	0.4315	0.4175	0.3841–0.5594	0.4700	0.4674	0.3841–0.5177	0.4342	0.4008
Anopheles kochi	0.1086–0.1336	0.1189	0.1169	0.2004–0.2338	0.2008	0.2004	0.2756–0.3006	0.2839	0.2839
Anopheles tessellatus	0.0668–0.1336	0.1086	0.1169	0.1002–0.1503	0.1281	0.1336	0.1587–0.2255	0.1795	0.1670
Pseudomyzomyia									
Anopheles indefinitus, fresh water	0.5511–0.8851	0.7313	0.7515	0.7181–1.0020	0.8655	0.9185	0.7348–1.1189	0.9223	0.9185
Anopheles indefinitus, salt water	0.5344–0.9185	0.7757	0.7515	0.6847–1.0354	0.8704	0.8684	0.7849–1.0521	0.9297	0.9018
Anopheles limosus	0.5344–0.8016	0.6501	0.6513	0.7849–1.0855	0.9507	0.9519	1.0187–1.2859	1.1511	1.1189
Anopheles litoralis	0.5845–1.0354	0.8393	0.8851	0.8183–1.2525	0.9965	1.0354	0.8684–1.2024	1.0633	1.1189
Anopheles ludlowi	0.5344–0.9018	0.7310	0.7849	0.6847–1.0020	0.8903	0.8517	0.8851–1.1022	1.0080	1.0187
Anopheles parangensis	0.5845–0.7515	0.6805	0.6847	0.6012–0.8350	0.7460	0.7515	0.8684–1.0020	0.9143	0.9185

Curiously, *cristatus,* which is different in the larval stage from the other species of the group, does not, in the pupal stage, possess any peculiarity that will readily segregate it from the rest. On the contrary, var. *balabacensis* whose larva is very much like that of *leucosphyrus* can easily be recognized in the pupal stage, for its relatively long spines, particularly those on segment IV. By average values *A*–IV of var. *balabacensis* is about four times as long as the corresponding spine of the other species. Except in *tessellatus,* branchings of the spines are usually found at least on *A*–VII. Branchings on *A*–V to *A*–VII are usually present in var. *balabacensis, cristatus,* and *kochi;* occasional branching is present also on *A*–IV of var. *balabacensis,* while sometimes *leucosphyrus* does not have any branches, even on *A*–VII. By normal occurrence and by average values, the spines of *kochi* and *tessellatus,* especially those on segments V and VI, are shorter than those of the other species under the group.

For the related *leucosphyrus* forms the reader is referred to part IV of these Notes.

Key to the species of group Neomyzomyia, based on pupal characters.

1. *A*–IV at least 0.167 mm long, usually longer. *leucosphyrus* var. *balabacensis.*
   A–IV much less than 0.167 mm long .... 2.
2. *A*–V at least 0.2 mm long, usually much longer .... 3.
   A–V much less than 0.2 mm long .... 4.
3. At least *A*–VI and *A*–VII with branches .... *cristatus.*
   Branchings of spines, if present, only on *A*–VII .... *leucosphyrus* and probably also *leucosphyrus* var. *riparis.*
4. *C'* simple; *B*–V and *B*–VII branched 3 to 5 and 2 or 3, respectively. *kochi.*
   C' branched 5 to 8; *B*–V and *B*–VII branched 8 to 12 and 6 to 10, respectively .... *tessellatus.*

GROUP MYZOMYIA

The three species of this group are hard to separate in the pupal stage. By average values in lengths of the spines it may be possible to differentiate *mangyanus* quite readily, but average values have very limited practical usefulness. The following key is offered merely as a general guide in differentiating the pupæ of the three species:

Key to the species of the group Myzomyia, based on pupal characters.

1. *A*–IV from 0.5 to 0.7 mm, average 0.6 mm long; *A*–III usually over twice the length of *A*–II .... *mangyanus.*
   A–IV from 0.25 to 0.5 mm, average 0.397 mm long; *A*–III usually less than twice as long as *A*–II .... 2.

2. *B*–III usually with less than 10 branches; *B*–VII branched around 4; *A*–III distinctly blunt .... *filipinæ.*
   B–III with at least 10 branches; *B*–VII branched around 7; *A*–III usually pointed .... *minimus* var. *flavirostris.*

Branching of *A*–VII whenever present is by simple splitting of the spine into two, unlike that in the species of the group *Neomyzomyia* where more than one branch are usually present in each spine; the branches, however, in the group *Myzomyia* are often much longer than in the group *Neomyzomyia.* The highest percentage of branching on *A*–VII in the group *Myzomyia* is among specimens of *mangyanus,* of which 19 per cent in our series have this peculiarity.

GROUP PSEUDOMYZOMYIA

Following Morishita's opinion (1935) which was previously indicated by King (1931), *Anopheles indefinitus* is here considered specific in status instead of being a variety of *subpictus.* But whether or not the local forms of fresh- and salt-water *indefinitus* are distinct from each other is yet to be determined by studies on their eggs. Walch and Walch-Sorgdrager (1934) have shown from egg characters that fresh- and salt-water *subpictus* in Netherland India are different from each other. It can hardly be expected that differences in the two local forms of *indefinitus* could be found in the pupal stage when even distinct species under the group are very similar in this stage. Moreover, King (1931) and others have found no difference between these forms in the larval or adult stages.

The peculiar case reported by Sen (1935) of a female *Anopheles vagus,* from whose eggs larvæ and adults of both *vagus* and *subpictus* types were produced, if proved correct by further experiments, will cause drastic changes in the classification of the group, and possibly a return to the old usage of *rossi* as embracing all these allied forms. Sen's discovery will throw some doubt on the best methods of classification. However, as reported by Walch and Walch-Sorgdrager (1934) there is a big difference between the eggs of *subpictus* and of *vagus* in Netherland India (which is likely true also in the Philippines), while in India Christophers and Barraud (1931) found the eggs of these two species very much alike. It may be supposed, therefore, that the two forms are not as distinctly separated genotypically in India as they are in other places, which makes possible the occurrence of such a case as noted by Sen. Otherwise the interracial sterility of such less distinguishable forms (mor-

phologically), as certain varieties of *maculipennis* reported by de Buck, Schoute, and Swellengrebel (1934), cannot be understood, since the distinctly different forms (morphologically) *subpictus* and *vagus* are fertile.

Of the species under group *Pseudomyzomyia, A. parangensis* alone possesses fairly marked characteristics; the others are very similar in characters.

Key to the species of group Pseudomyzomyia, based on pupal characters.

1. Paddle hair two-thirds or more the length of paddle; *R*–M and *C*–IV usually 7-branched (range 5 to 8 and 6 to 10, respectively). *parangensis.*
   Paddle hair less than two-thirds (usually less than half) the length of paddle; *R*–M and *C*–IV branched less than 7 (range 1 to 5 and 1 to 6, respectively) .... 2.
2. Hairs *T*, *U*, and external 1–II fairly stout and extending out prominently; 1–IV usually 3-branched (range 2 to 5) .... *indefinitus.*
   Hairs, *T*, *U*, and external 1–II more slender, usually curved; 1–IV usually simple (range 1 to 3) .... 3.
3. Accessory denticles on anterolateral border of paddle many and distinct. *ludlowi.*
   These denticles few and indistinct .... 4.
4. 1–IV 2- or 3-branched; *C*–IV usually 3-branched (range 3 to 5). *vagus* var. *limosus.*
   1–IV simple; *C*–IV usually simple .... *litoralis.*

GROUP NEOCELLIA

The group *Neocellia* is included in part V of these Notes.

SUMMARY AND CONCLUSIONS

1. Pupal characters of the species of the subgenus *Myzomyia* are presented.

2. It is shown that the groups can be readily separated, but the species under certain groups are very much alike and can hardly be differentiated from one another; the keys for such groups are given merely as general guides.

3. It is indicated that probably the best method of classifying Philippine species of *Anopheles* is by a combination of the characters in all stages; such as those found in the eggs, larvæ, pupæ, and adults. It is also indicated that probably the Indian forms of *subpictus* and *vagus* are not identical with *subpictus* and *vagus* of Netherland India, and the Philippines; those of India are apparently more closely related than those of other places, which makes possible the peculiar case reported by Sen. If this is correct, crosses between *indefinitus* and *vagus* var.

limosus in the Philippines probably do not take place, or if they do the resulting eggs or imagines are very likely sterile.

REFERENCES

To the long lists of references given in the previous parts of these Notes the following should be added:

1. BAISAS, F. E., and STEPHEN M. K. HU.
Anopheles hyrcanus var. sinensis of the Philippines and certain parts of China, with some comments on A. hyrcanus var. nigerrimus of the Philippines. Monthly Bull. Bur. of Health **16** (1936) 205–242.
2. BUCK, A. DE, E. SCHOUTE, and N. H. SWELLENGREBEL.
Crossbreeding experiments with Dutch and foreign races of Anopheles maculipennis. Riv. di Malar. **13** (1934) 1–29.
3. Central Malaria Bureau, India.
Revised and new descriptions of Indian Anopheles. Paludism (1910–1912) 66–71.
4. EVANS, A. M.
On certain distinguishing characters observed in Anopheles funestus Giles. Ann. Trop. Med. and Parasit. **24** (1930) 587–592.
Further notes on African anophelines, with a description of a new group of Myzomyia. Ann. Trop. Med. and Parasit. **28** (1934) 549–570.
5. EVANS, A. M., and H. S. LEESON.
The funestus series of Anopheles in Southern Rhodesia, with a description of a new variety. Ann. Trop. Med. and Parasit. **29** (1935) 33–47.
6. GATER, B. A. R.
Aids to the identification of Anopheles imagines in Malaya (1935) 1–242.
7. KING, W. V., and F. E. BAISAS.
A new species and a new variety of Philippine Anopheles related to Anopheles leucosphyrus Dönitz. Proc. Entom. Soc. Wash. **38** (1936) 79–89.
8. MORISHITA, K.
Anopheles (Myzomyia) indefinitus (Ludlow, 1904) in Formosa. Adjustment of A. formosaensis II, A. rossi, and A. vagus problem. Journ. Med. Assoc. Formosa **34** (1935) 558–578.
9. SEN, P.
An instance of species anomaly amongst anophelines. Rec. Mal. Surv. India **5** (1935) 207–209.
10. TOUMANOFF, C.
Recherches sur le frequence saisonniere de diverses speces anopheliennes au Tonkin Bassin du fleuve Rouge. Premiere note: A. (Myz.) minimus Theo. et A. (Myz.) aconitus Dönitz. Bull. Soc. Path. Exot. **26** (1933) 857–863.
Recherches sur, etc. Deuxieme note: A. (Pseudomyz.) vagus Dönitz. Bull. Soc. Path. Exot. **26** (1933) 864–867.
Caracteristique des representants du rossii-ludlowi groupe de l'Indochine. Premiere note: A. subpictus Grassi. Bull. Soc. Med. Chirur No. 7 (1934) Août-Sept. (Reprint pp. 1–17.)

ILLUSTRATIONS

[The illustrations were drawn with the aid of a camera lucida; the respiratory trumpets from unmounted specimens; all the others from flat preparations.]

PLATE 1. ANOPHELES FILIPINÆ MANALANG

Parts of metathorax and abdominal segments I, II, and VI. Designation of parts, hairs, and spines applies to corresponding parts, hairs, and spines of other illustrations. *R*, *P*, and *O*, hairs of metathorax. *H*, *K*, *L*, *M*, *S*, *T*, and *U*, hairs of abdominal segment I; *t* is the base of dendritic tuft. *A*, spine; *C*, large dorsal hair of abdominal segment II; 1–1, 2–2, 3, 4, and 5, other dorsal hairs of abdominal segment II. *A*, spine; *B*, *C*, and *C'*, large dorsal hairs of abdominal segment VI; 1, 2, 4, and 5, other dorsal hairs of abdominal segment VI.

PLATE 2. ANOPHELES FILIPINÆ MANALANG

FIG. 1. Respiratory trumpet.
2. Paddle and part of abdominal segment VIII. Designation of parts, hairs, and spine applies to corresponding parts, hairs, and spine of other illustrations. *A*, spine; *A'*, accessory hair of spine; 5, dorsal hair of abdominal segment VIII. *e*, external border of paddle; other parts of paddle as labeled.

PLATES 3 AND 4. ANOPHELES MINIMUS VAR. FLAVIROSTRIS LUDLOW

PLATES 5 AND 6. ANOPHELES MANGYANUS BANKS

PLATE 7. PUPAL SPINES III TO VII

FIG. 1. *Anopheles minimus* var. *flavirostris* Ludlow.
2. *Anopheles filipinæ* Manalang.
3. *Anopheles mangyanus* Banks.

PLATES 8 AND 9. ANOPHELES INDEFINITUS LUDLOW

PLATES 10 AND 11. ANOPHELES VAGUS VAR. LIMOSUS KING

PLATES 12 AND 13. ANOPHELES LITORALIS KING

PLATES 14 AND 15. ANOPHELES LUDLOWI THEOBALD

PLATES 16 AND 17. ANOPHELES PARANGENSIS LUDLOW

PLATE 18. PUPAL SPINES III TO V

FIG. 1. *Anopheles ludlowi* Theobald.
2. *Anopheles litoralis* King.
3. *Anopheles parangensis* Ludlow.
4. *Anopheles vagus* var. *limosus* King.
5. *Anopheles indefinitus* Ludlow.

PLATES 19 AND 20. ANOPHELES KOCHI DÖNITZ

PLATES 21 AND 22. ANOPHELES TESSELLATUS THEOBALD

PLATE 23. PUPAL SPINES IV TO VII

FIG. 1. *Anopheles leucosphyrus* var. *balabacensis* Baisas.
2. *Anopheles leucosphyrus* var. *balabacensis* Baisas, showing much longer *A*–IV.
3. *Anopheles kochi* Dönitz.
4. *Anopheles leucosphyrus* Dönitz.
5. *Anopheles tessellatus* Theobald.
6. *Anopheles cristatus* King and Baisas, showing unusually long *A*–IV.
7. *Anopheles cristatus* King and Baisas, showing normal *A*–IV.

PLATE 24. DUPLICATION AND SPLITTING OF PUPAL SPINES

FIG. 1. *Anopheles leucosphyrus* var. *balabacensis* Baisas.
FIGS. 2, 3, and 4. *Anopheles litoralis* King.
FIG. 5. *Anopheles vagus* var. *limosus* King.
6. *Anopheles filipinæ* Manalang.
7. *Anopheles minimus* var. *flavirostris* Ludlow.
8. *Anopheles mangyanus* Banks.

PLATE 25. DENTICLES AND ACCESSORY DENTICLES OF PADDLE

FIG. 1. *Anopheles ludlowi* Theobald; anterolateral border of paddle.
2. *Anopheles litoralis* King; anterolateral border of paddle.
FIGS. 3 and 4. *Anopheles ludlowi* Theobald.
FIG. 5. *Anopheles vagus* var. *limosus* King.
6. *Anopheles litoralis* King.
7. *Anopheles indefinitus* Ludlow.
8. *Anopheles parangensis* Ludlow.

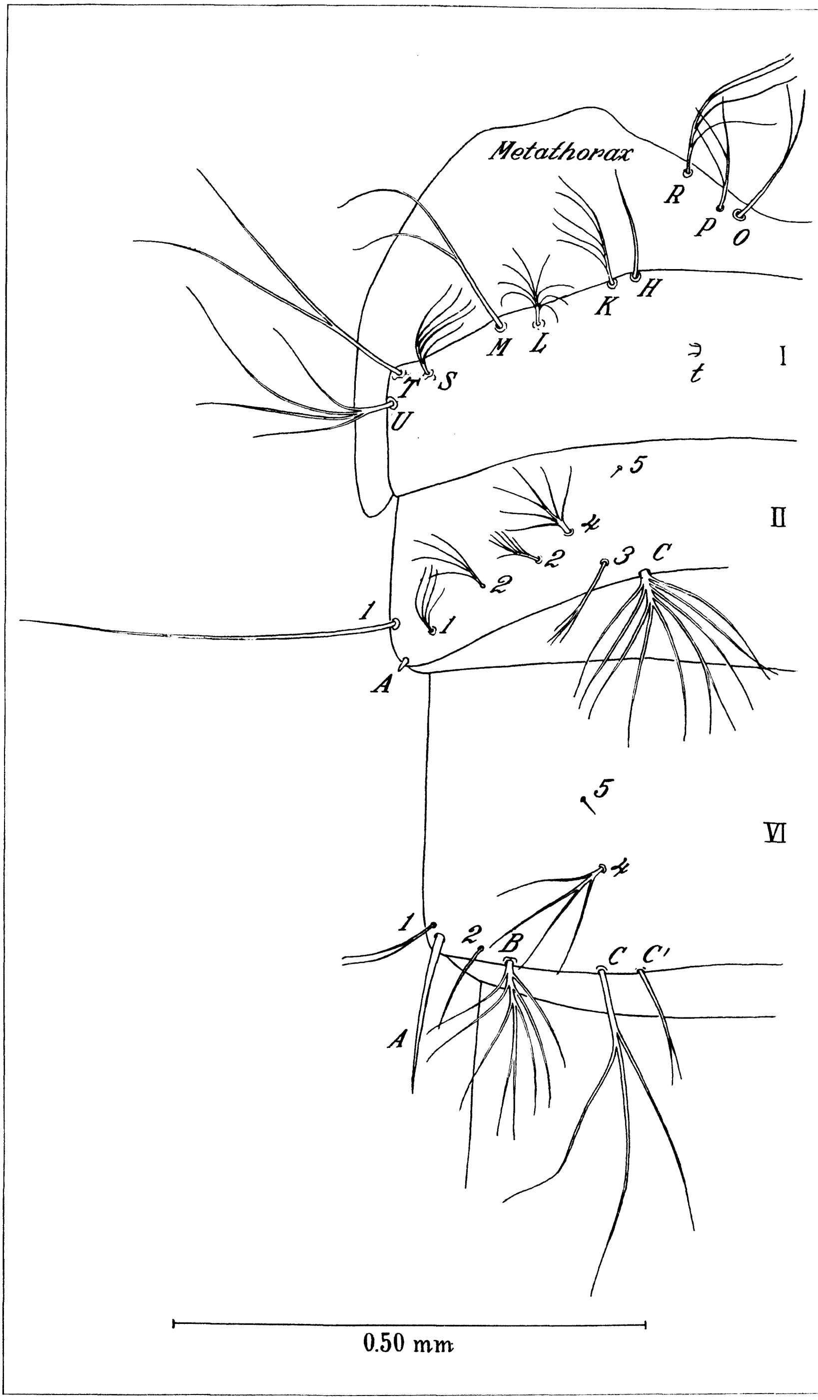


PLATE 1. ANOPHELES FILIPINÆ.

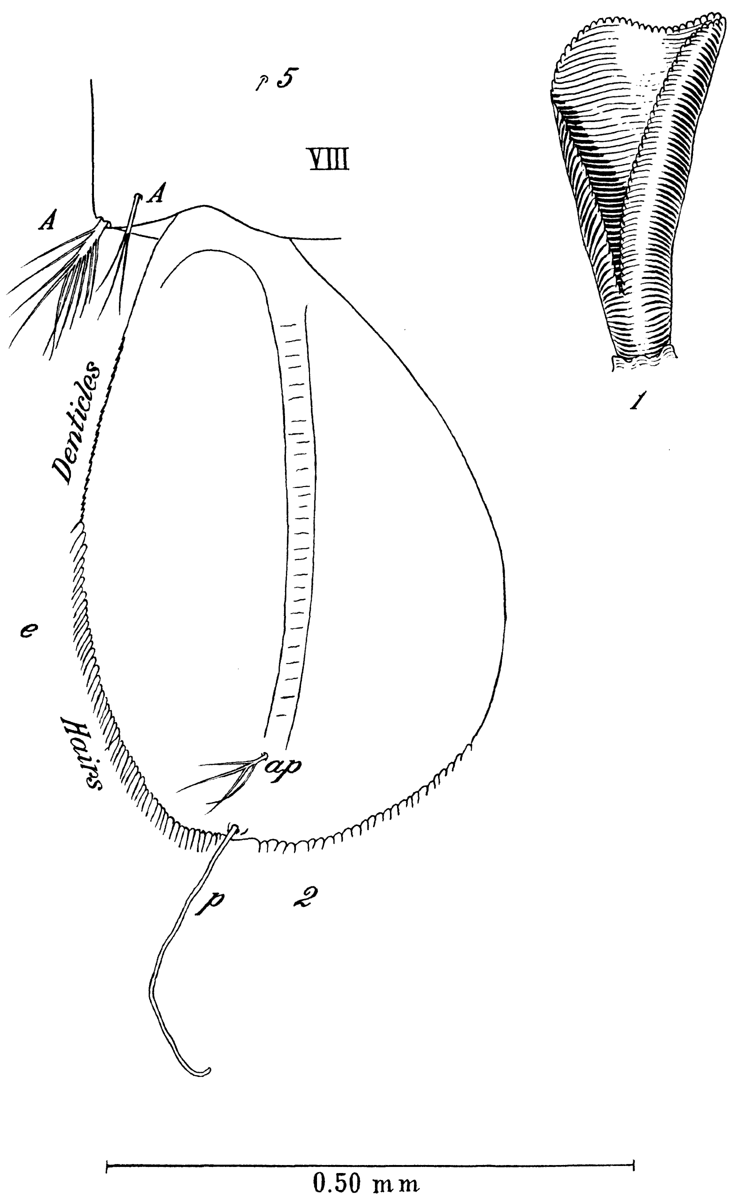


PLATE 2. ANOPHELES FILIPINÆ.

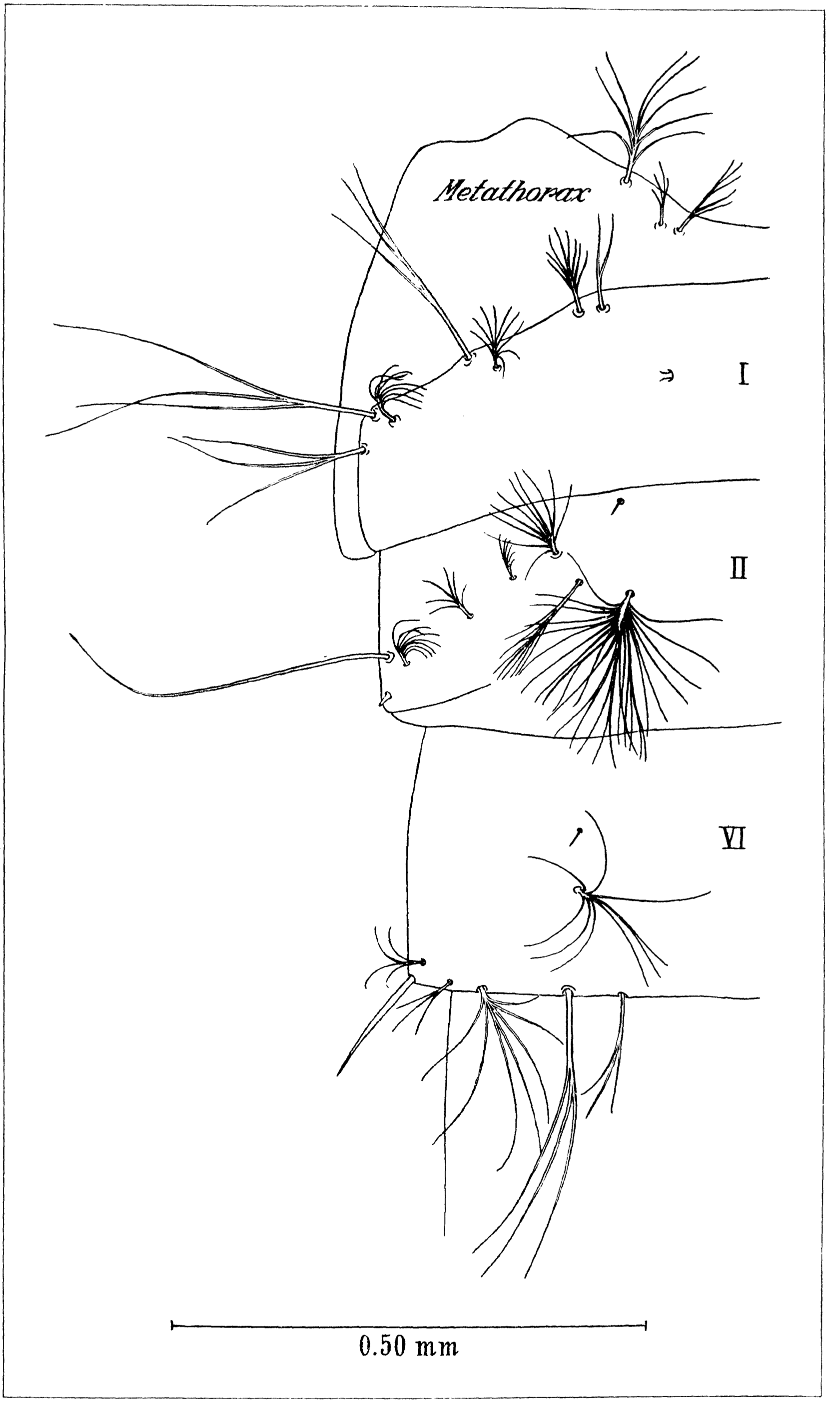


PLATE 3. ANOPHELES MINIMUS VAR. FLAVIROSTRIS.

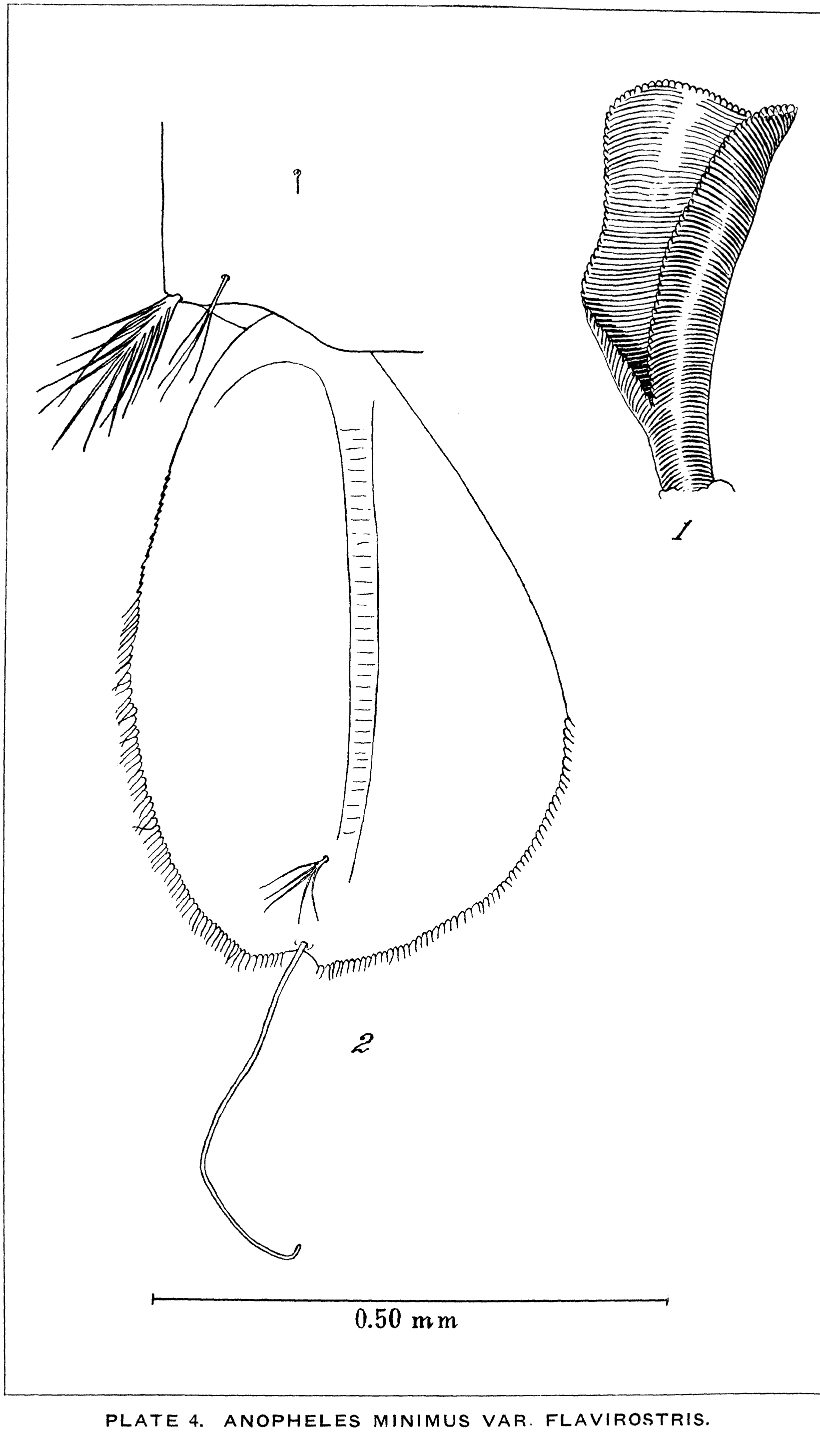


PLATE 4. ANOPHELES MINIMUS VAR. FLAVIROSTRIS.

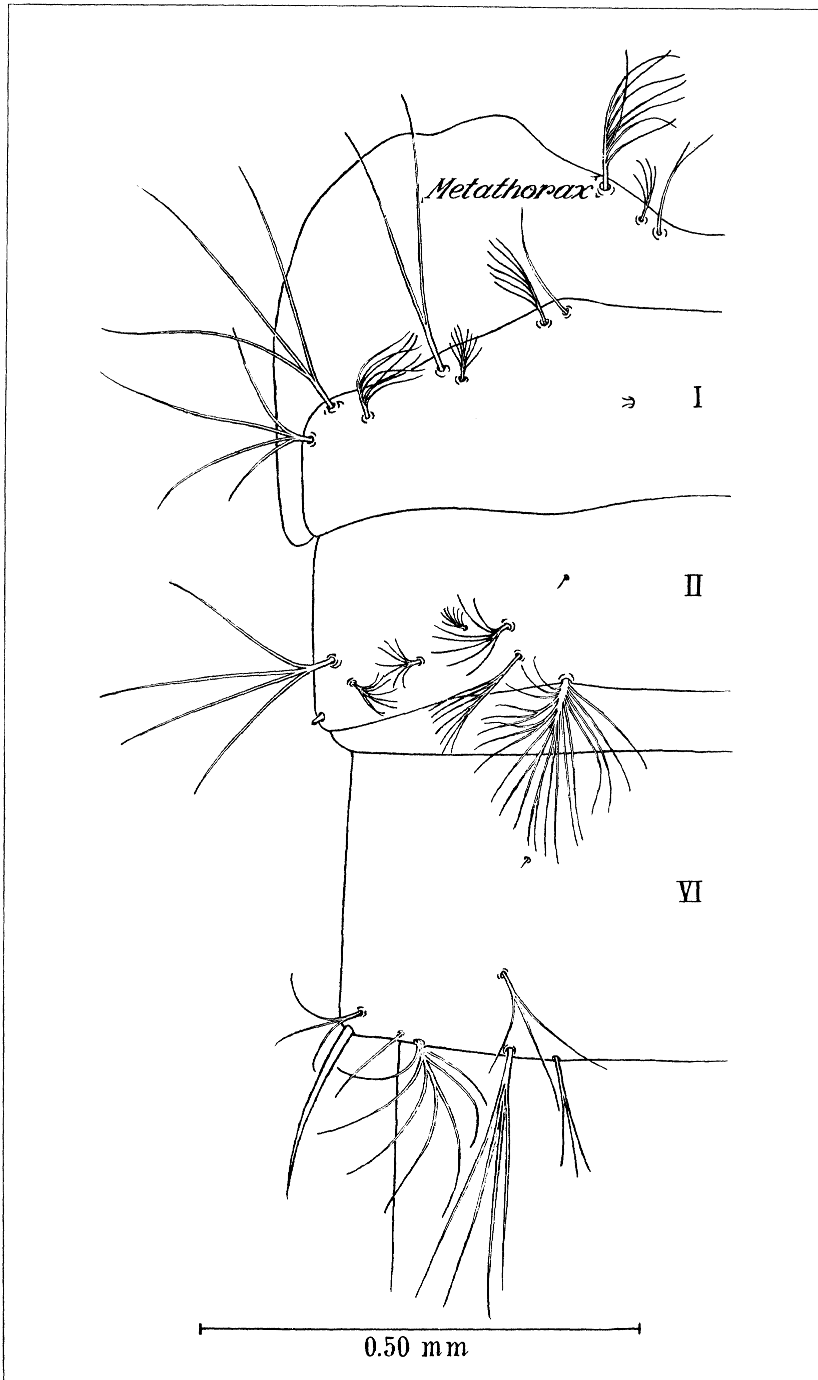


PLATE 5. ANOPHELES MANGYANUS.

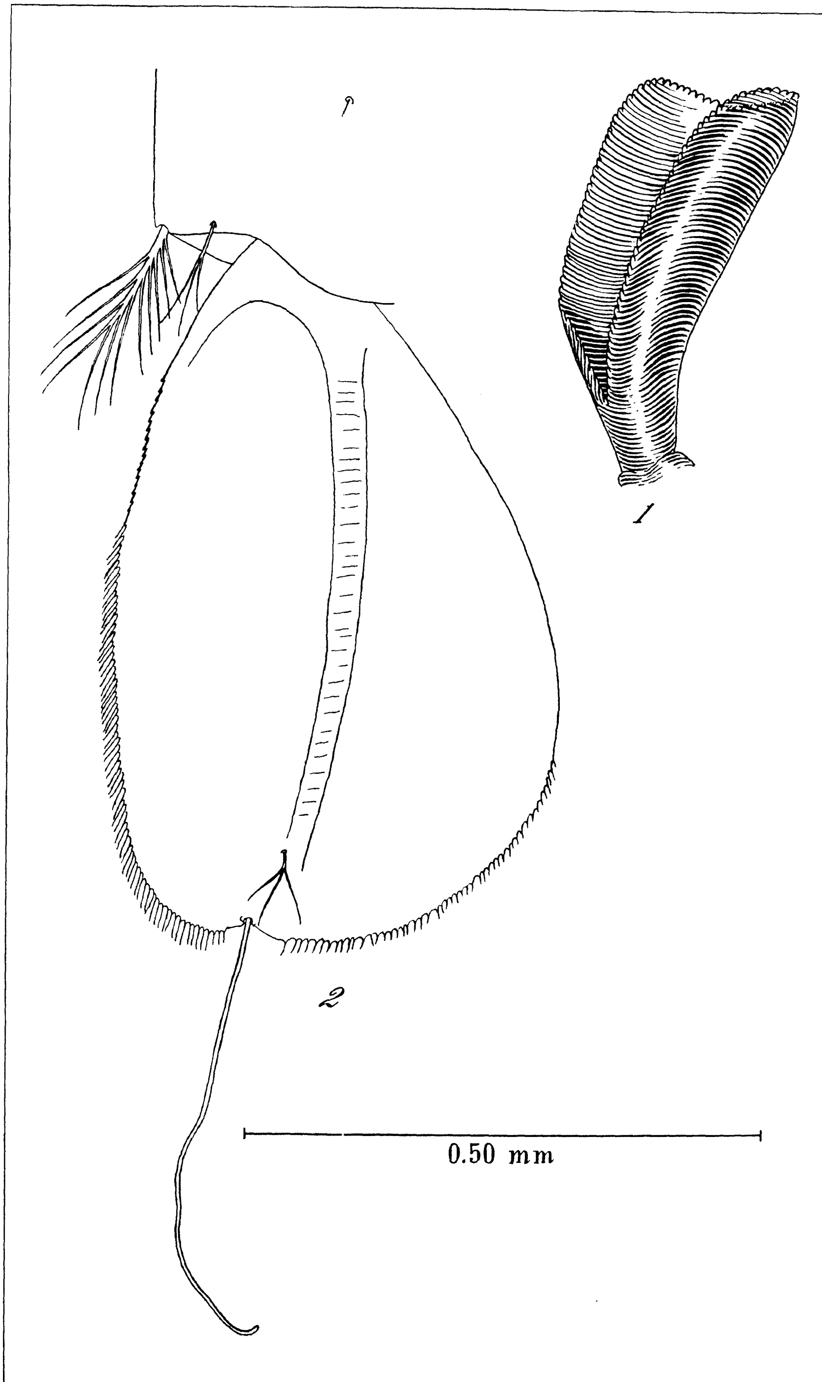


PLATE 6. ANOPHELES MANGYANUS.

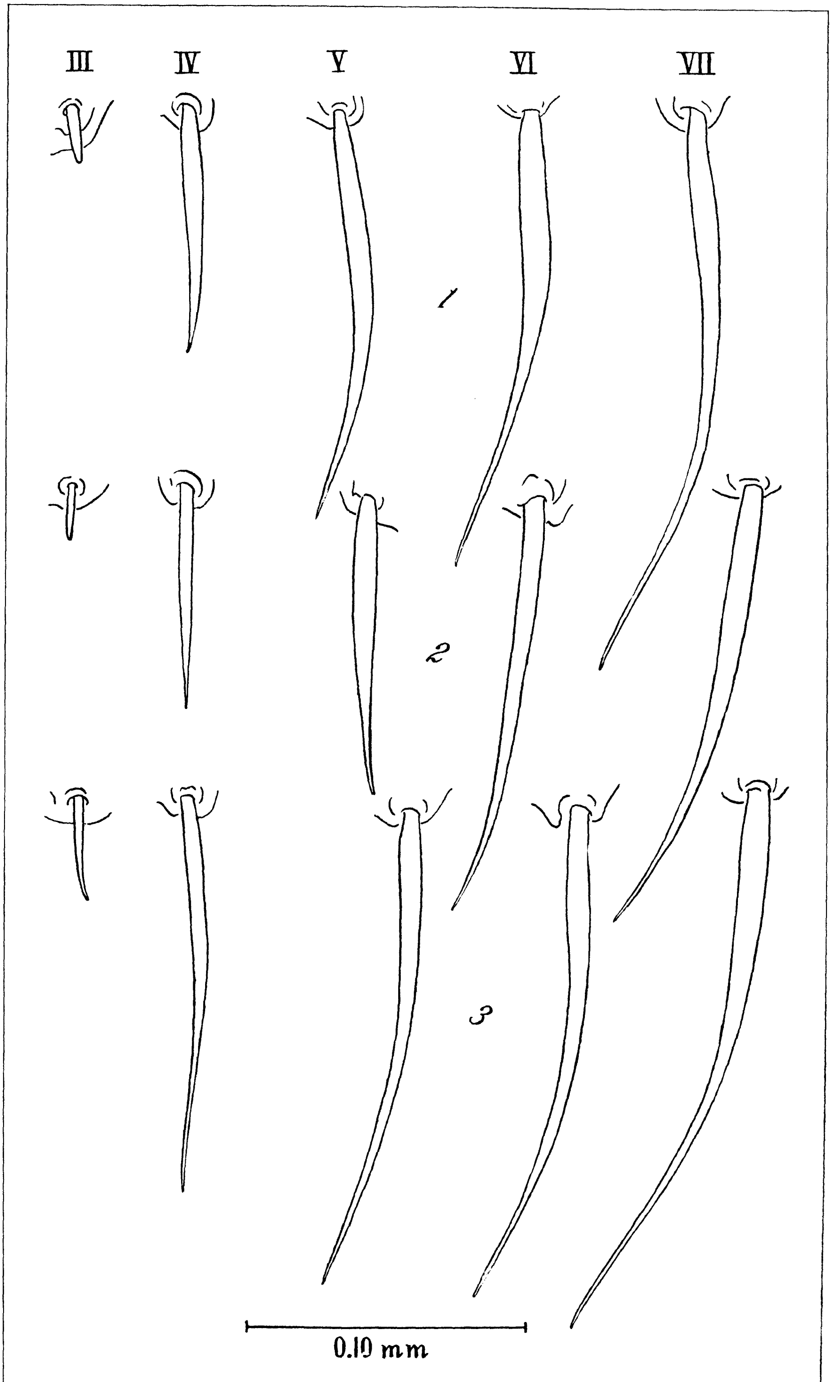


PLATE 7. PUPAL SPINES III TO VII; GROUP MYZOMYIA.

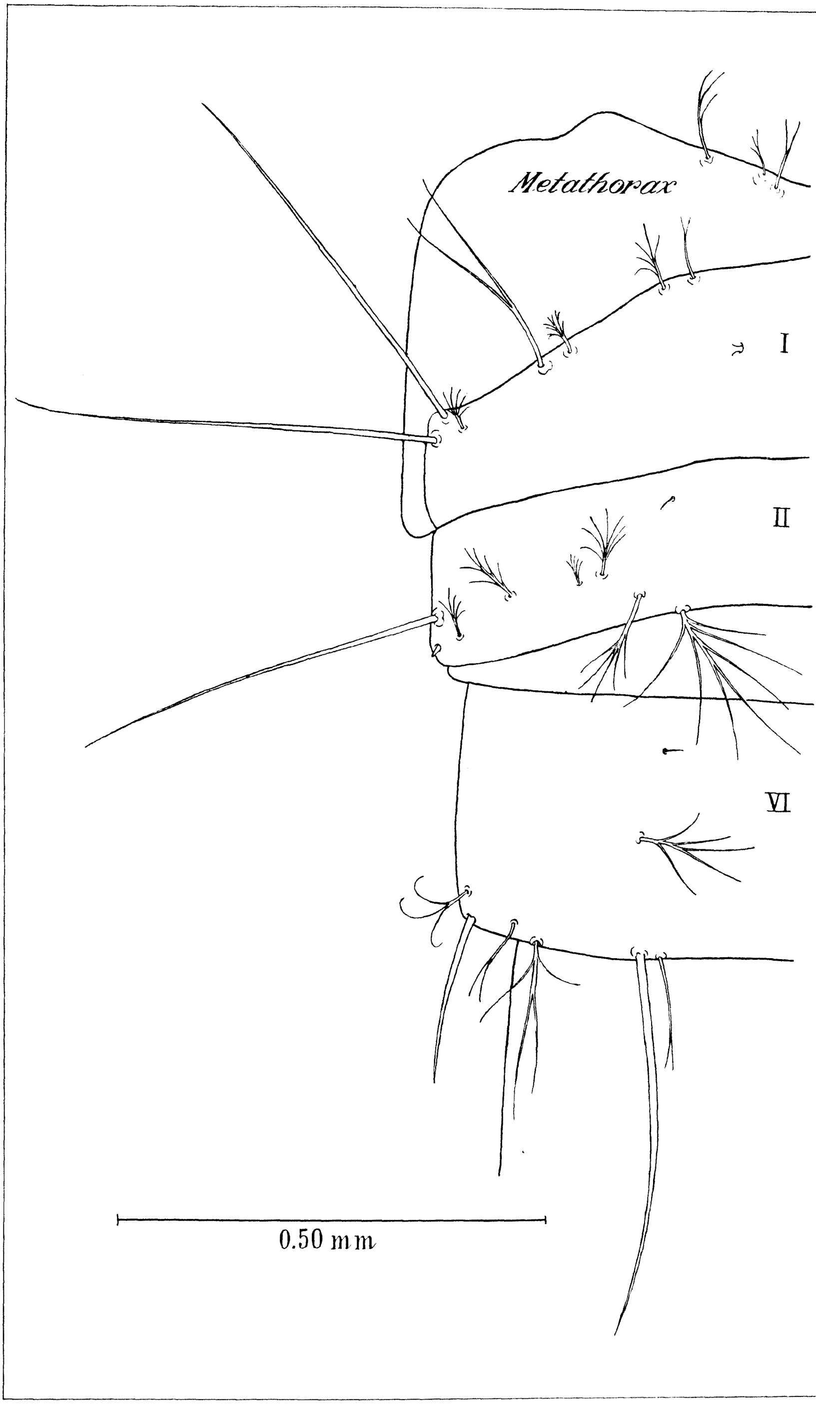


PLATE 8. ANOPHELES INDEFINITUS.

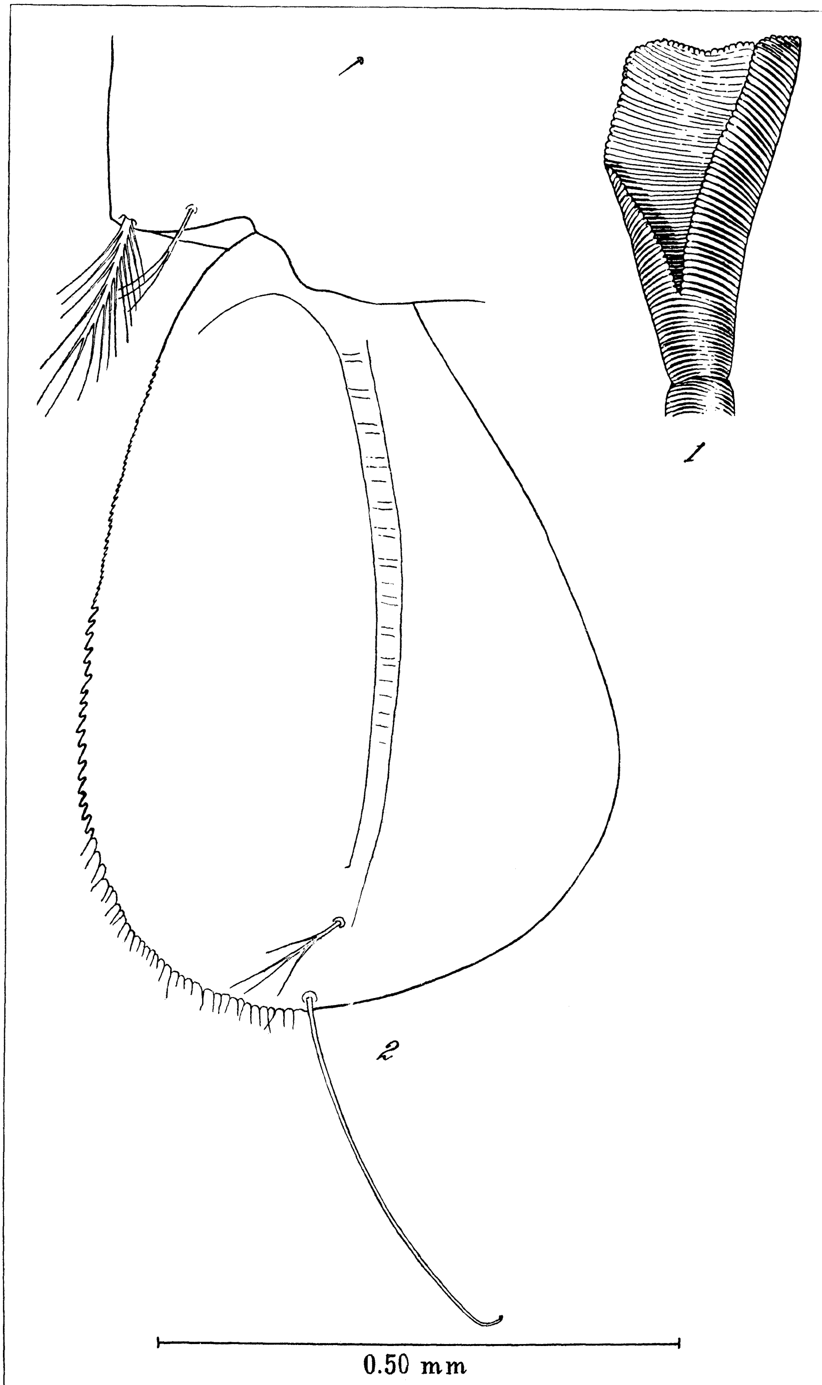


PLATE 9. ANOPHELES INDEFINITUS.

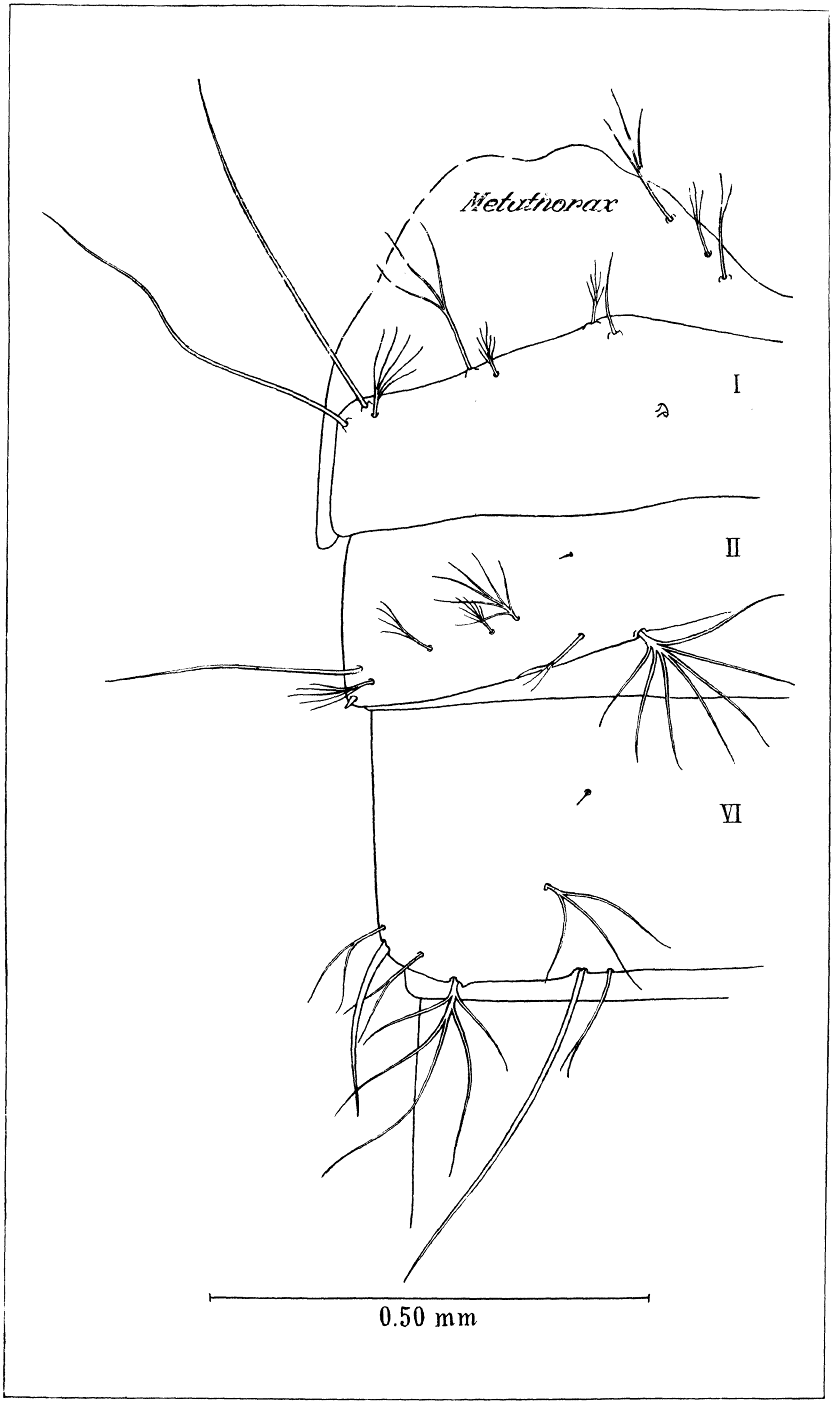


PLATE 10. ANOPHELES VAGUS VAR. LIMOSUS.

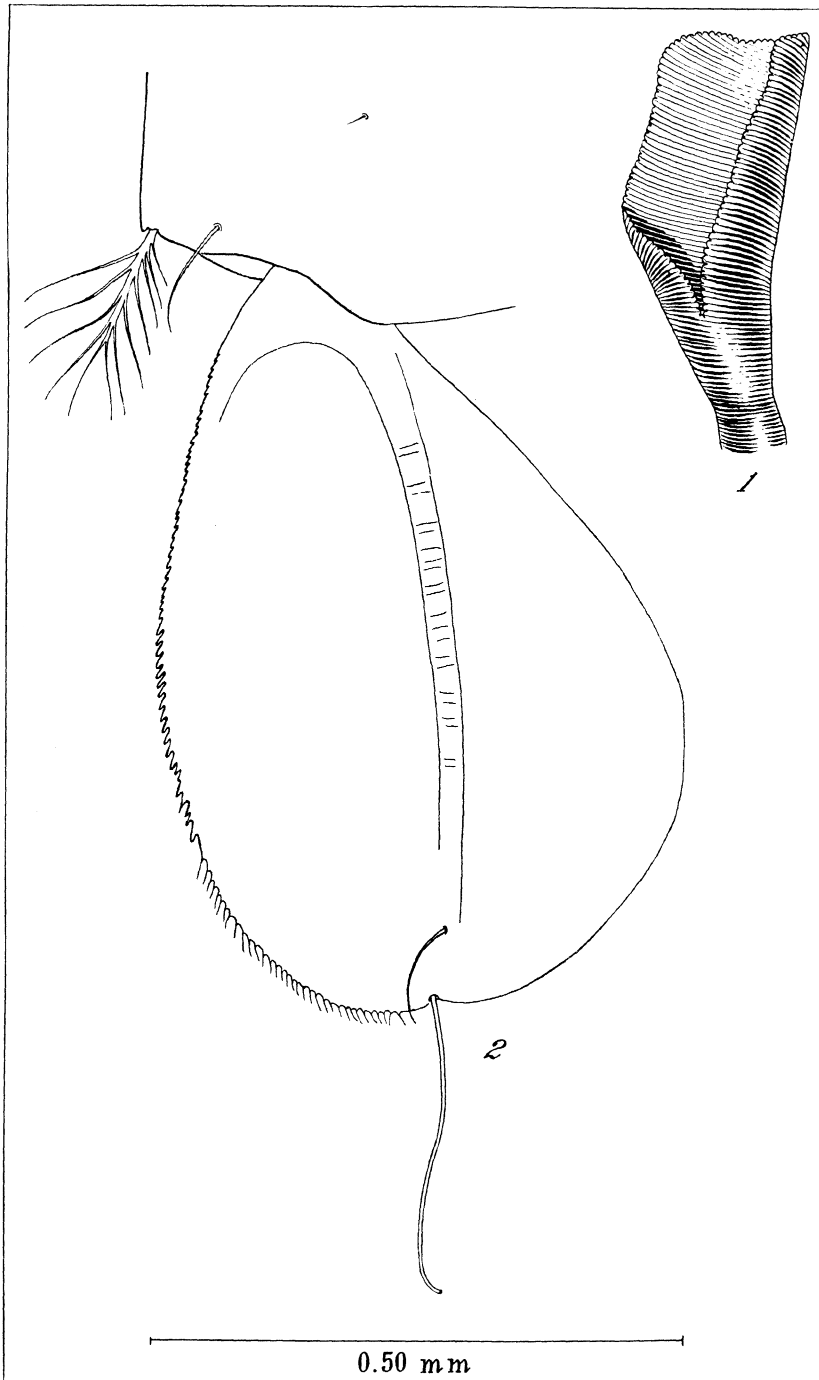


PLATE 11. ANOPHELES VAGUS VAR. LIMOSUS.

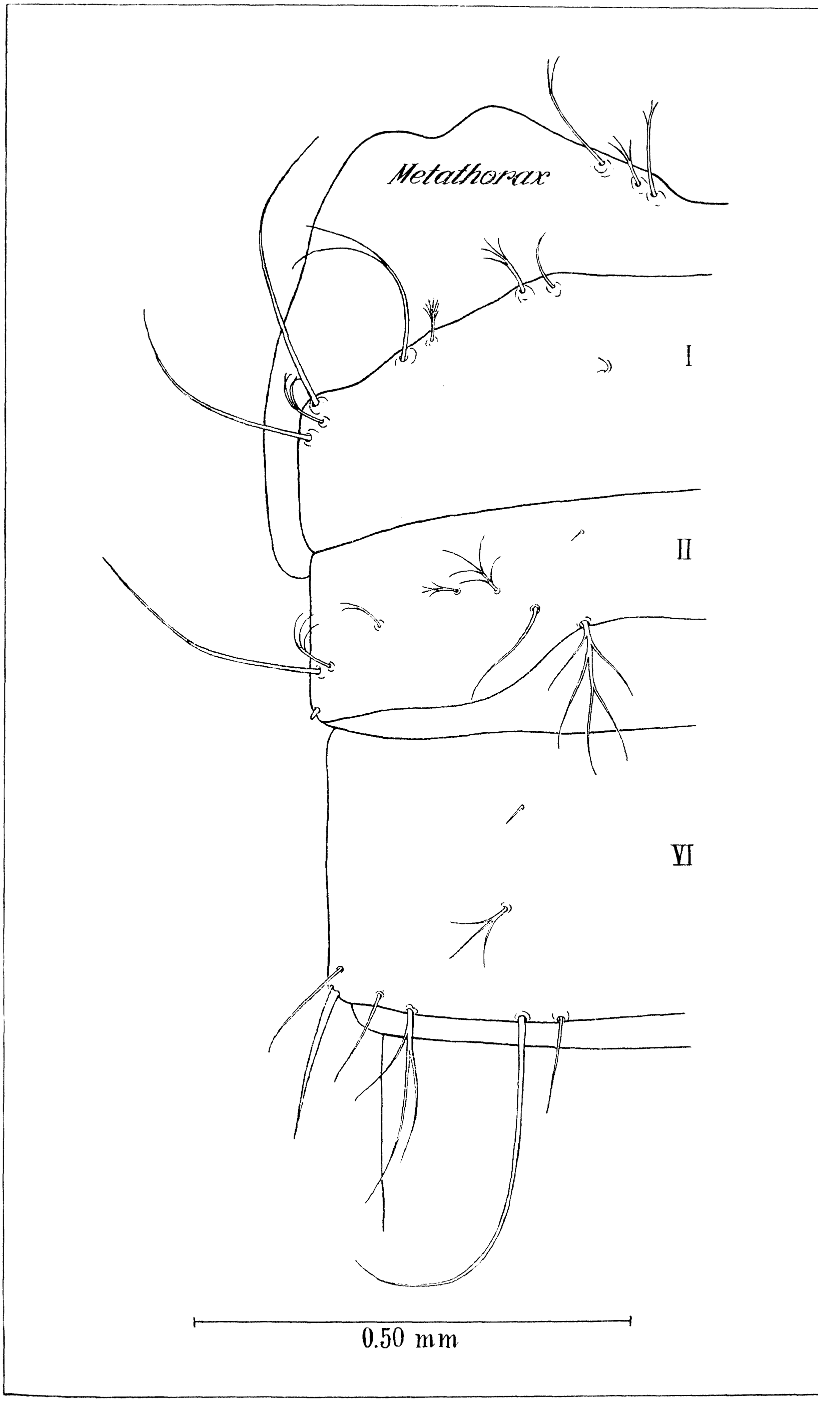


PLATE 12. ANOPHELES LITORALIS.

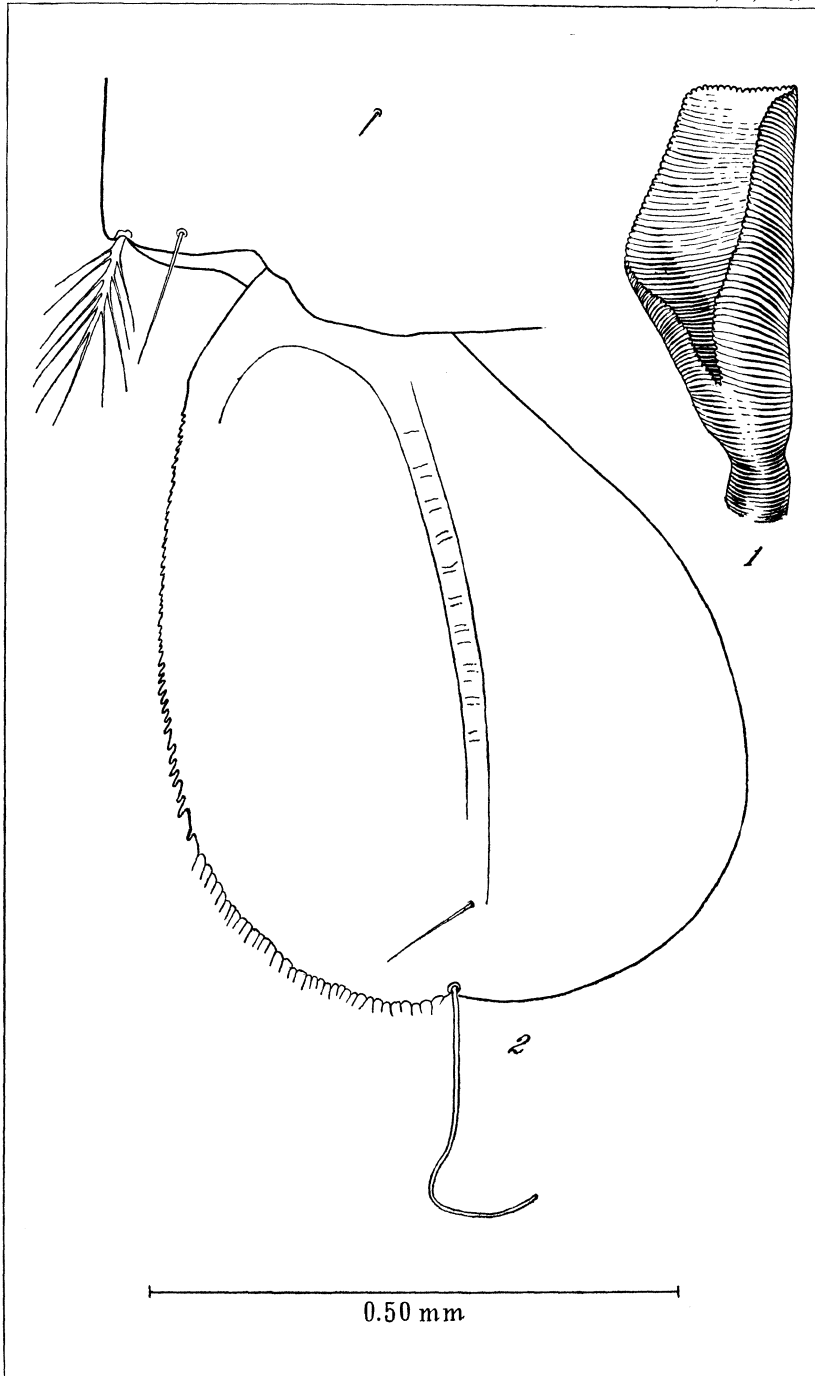


PLATE 13. ANOPHELES LITORALIS.

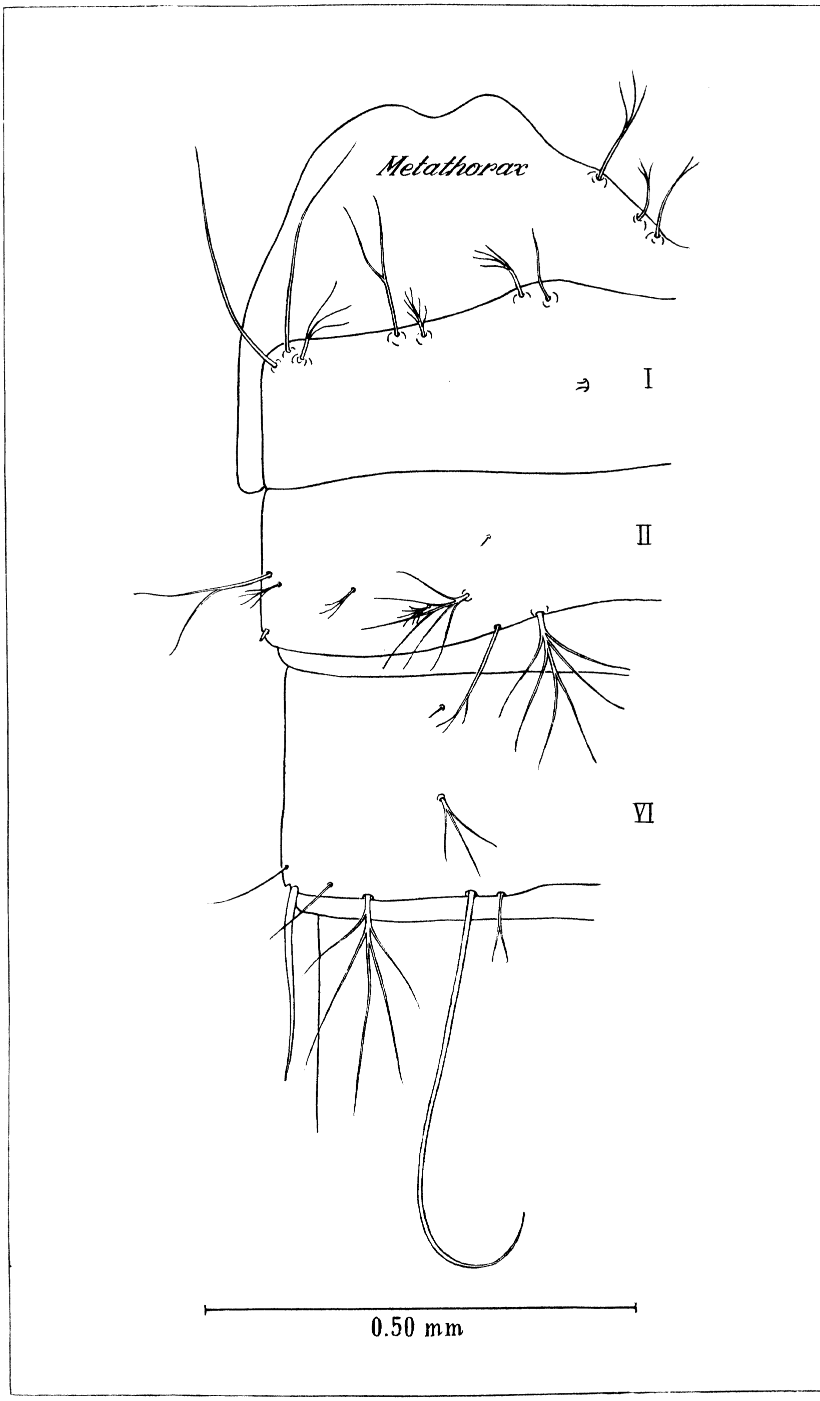


PLATE 14. ANOPHELES LUDLOWI.

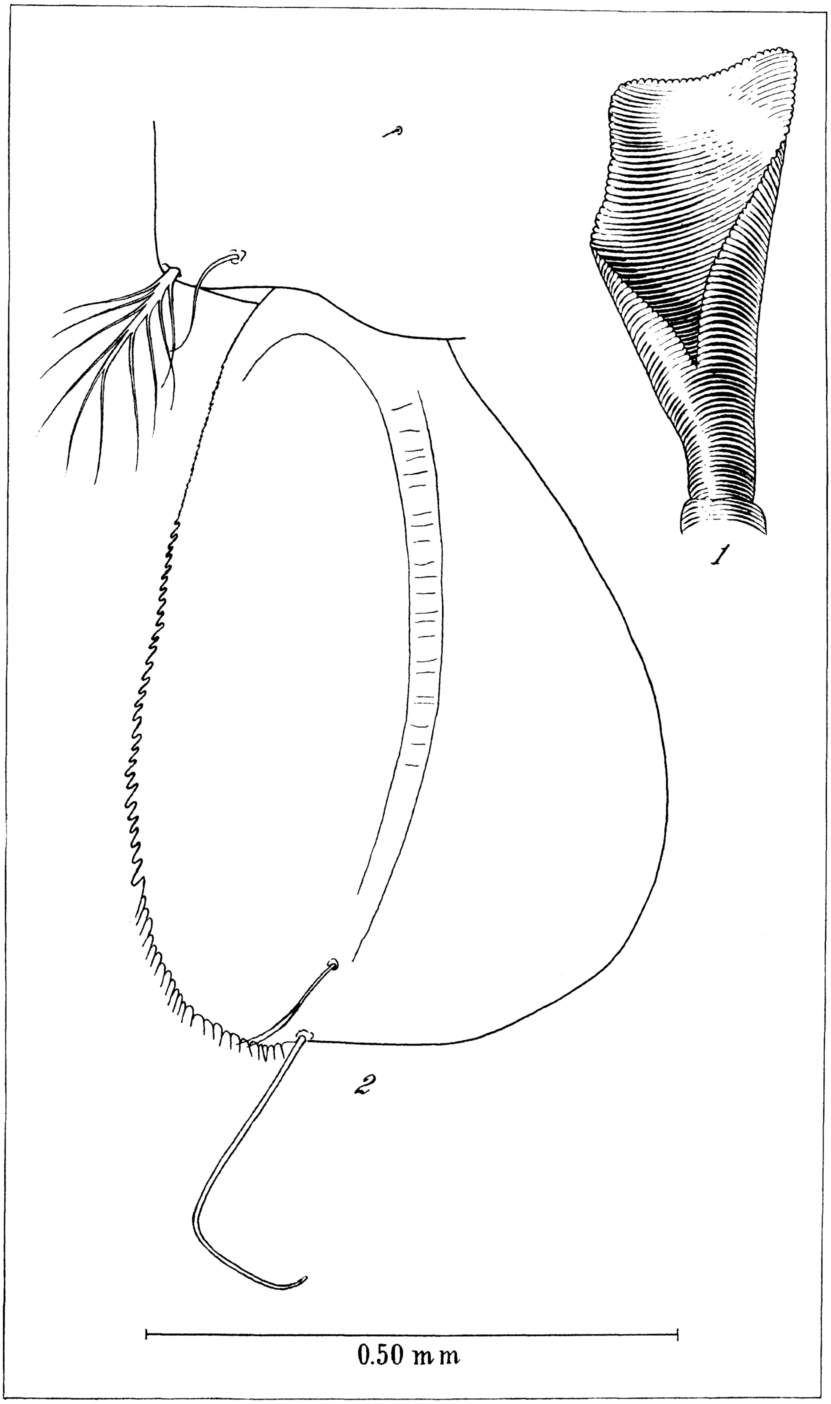


PLATE 15. ANOPHELES LUDLOWI.

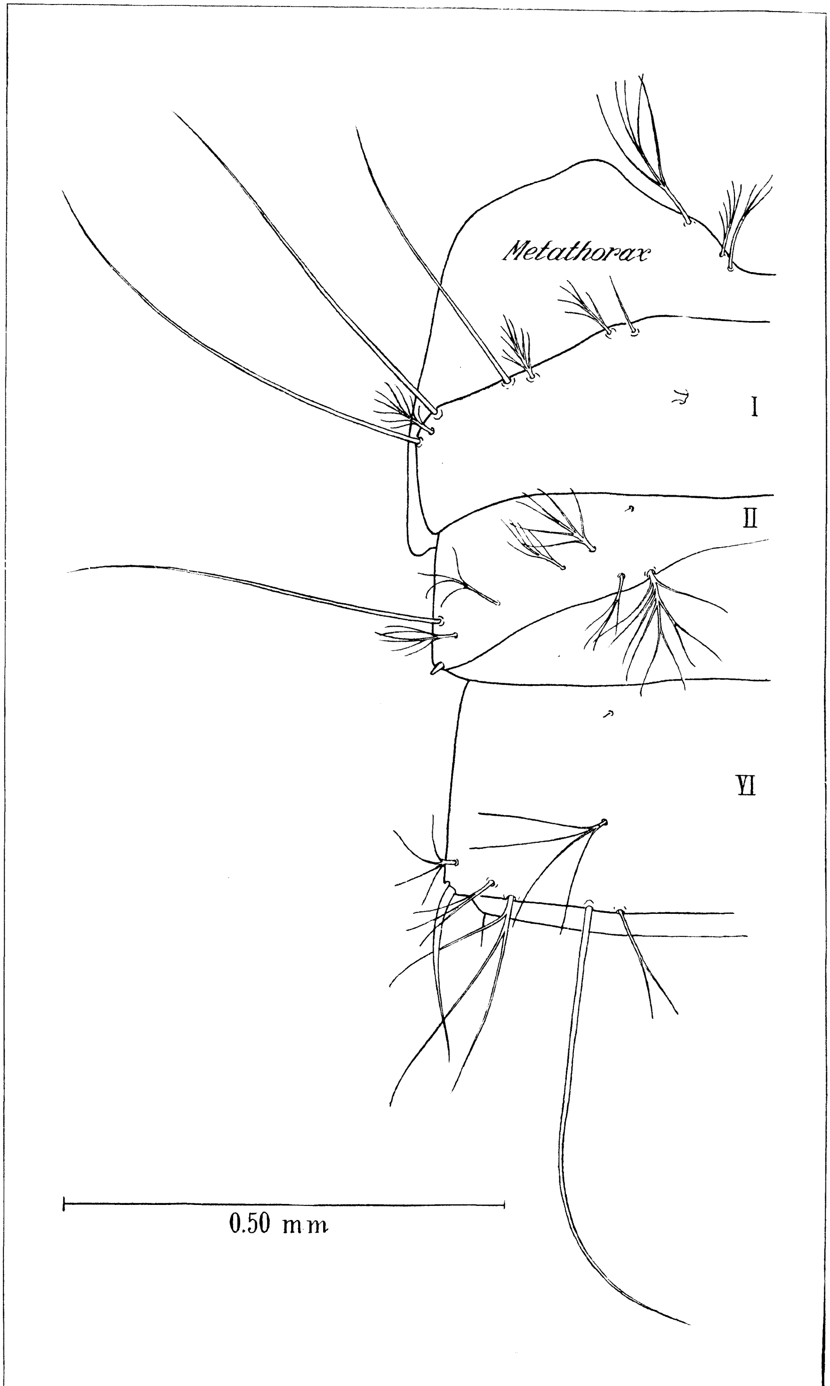


PLATE 16. ANOPHELES PARANGENSIS.

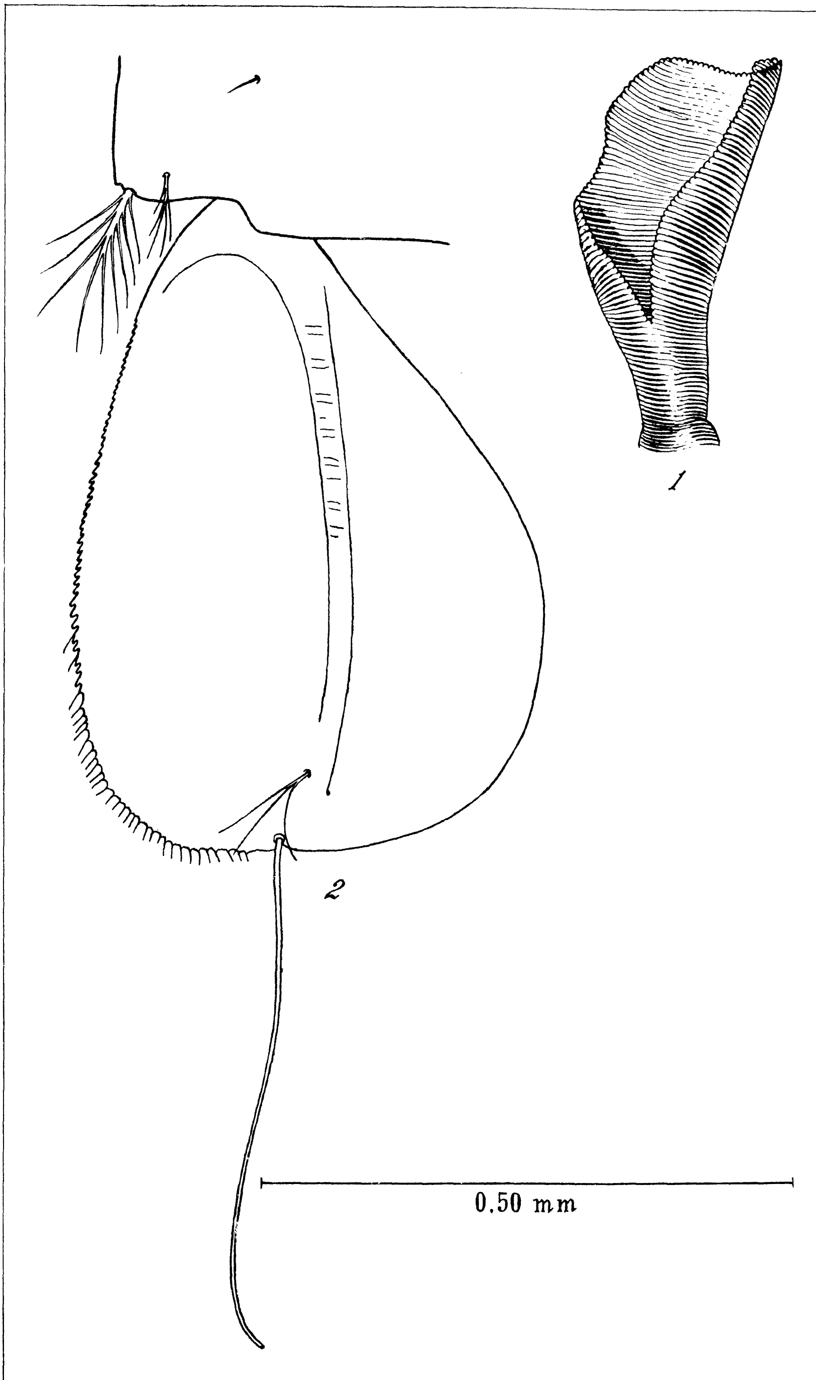


PLATE 17. ANOPHELES PARANGENSIS.

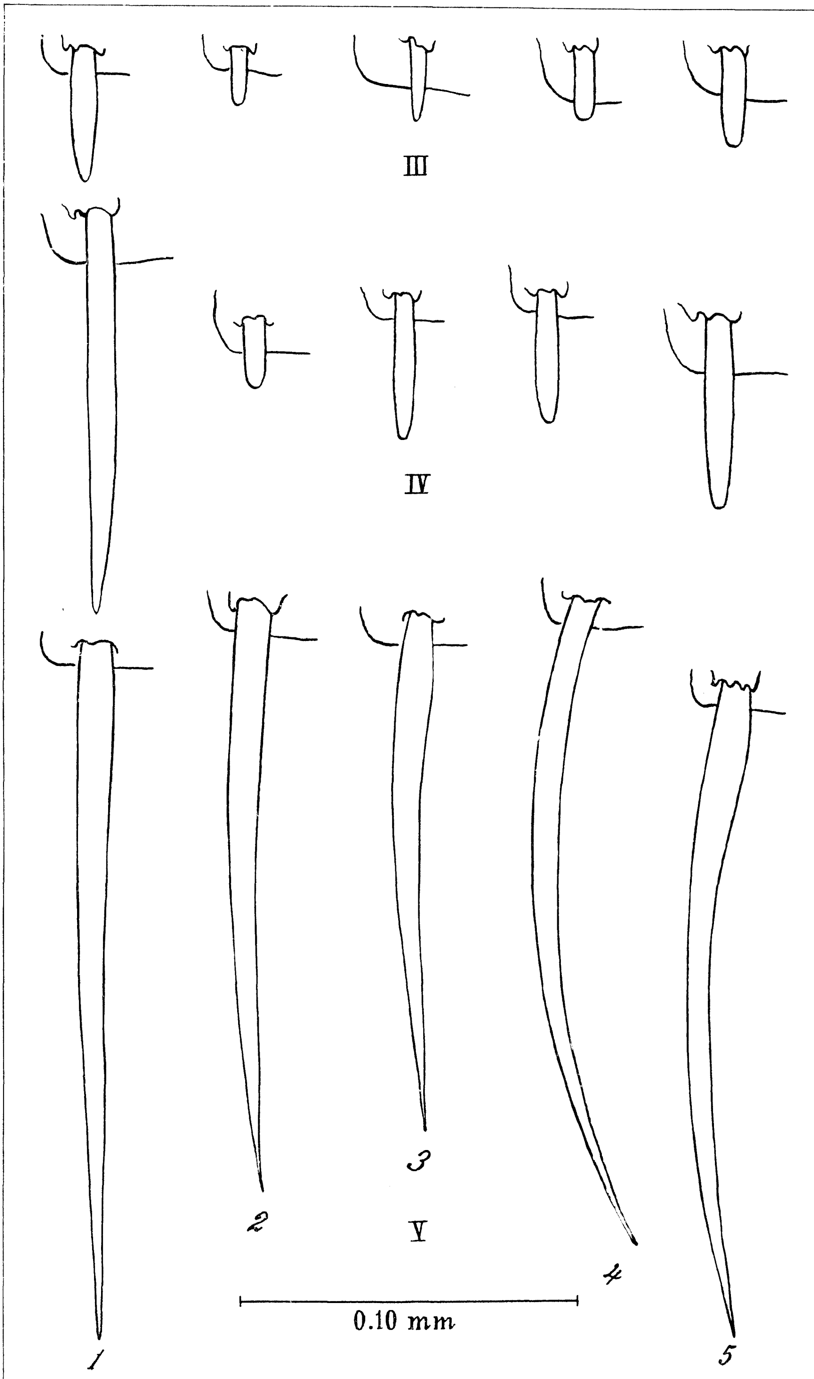


PLATE 18. PUPAL SPINES III TO V; GROUP PSEUDOMYZOMYIA.

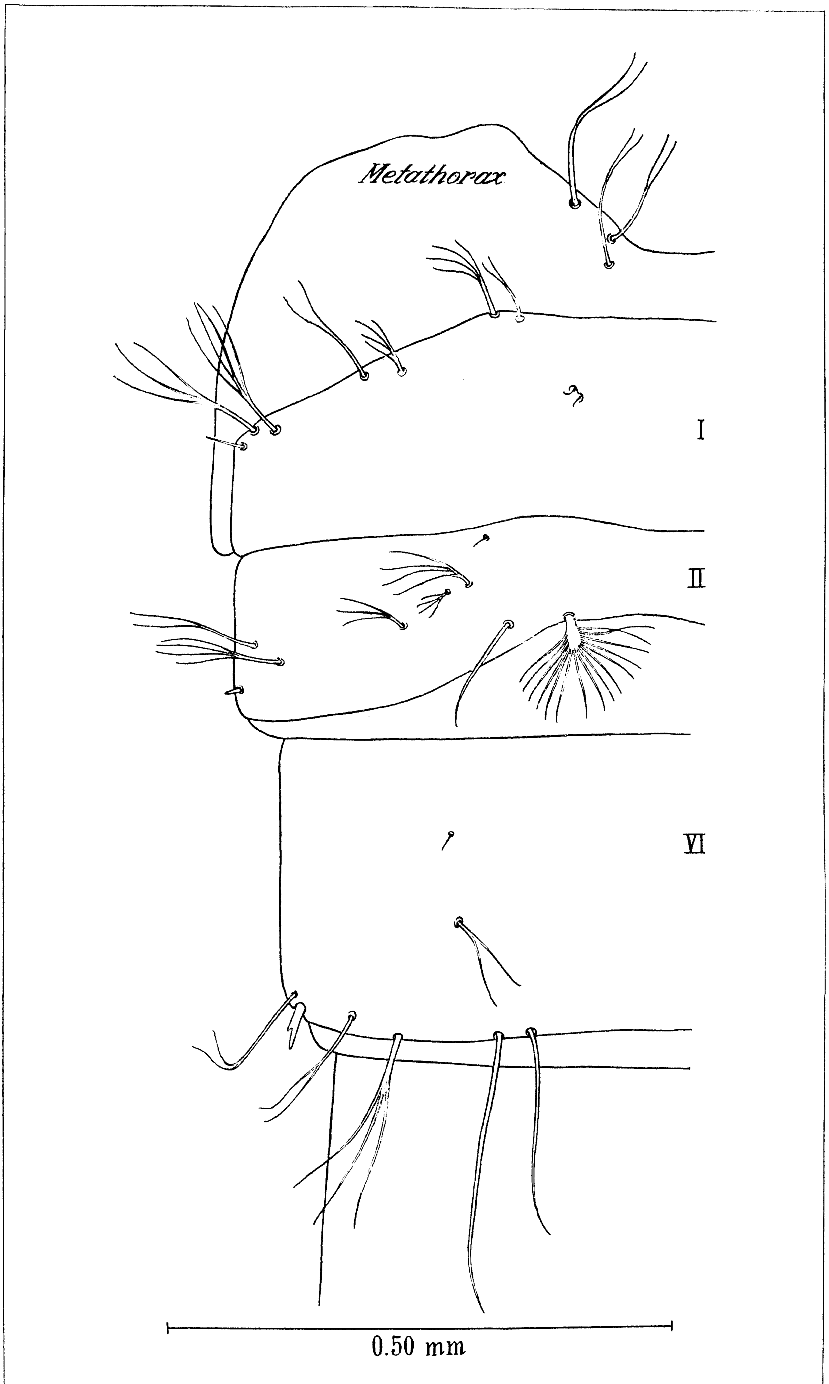


PLATE 19. ANOPHELES KOCHI.

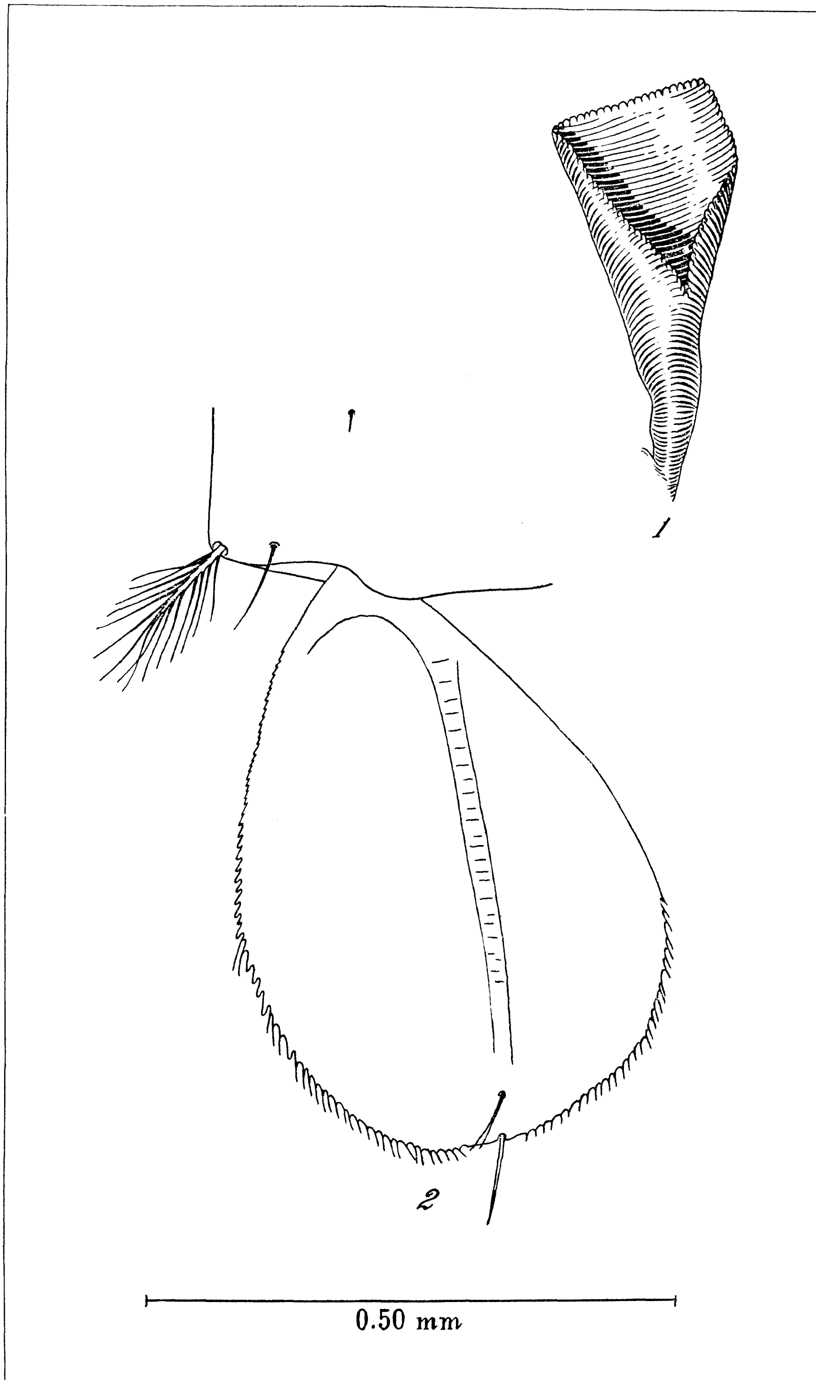


PLATE 20. ANOPHELES KOCHI.

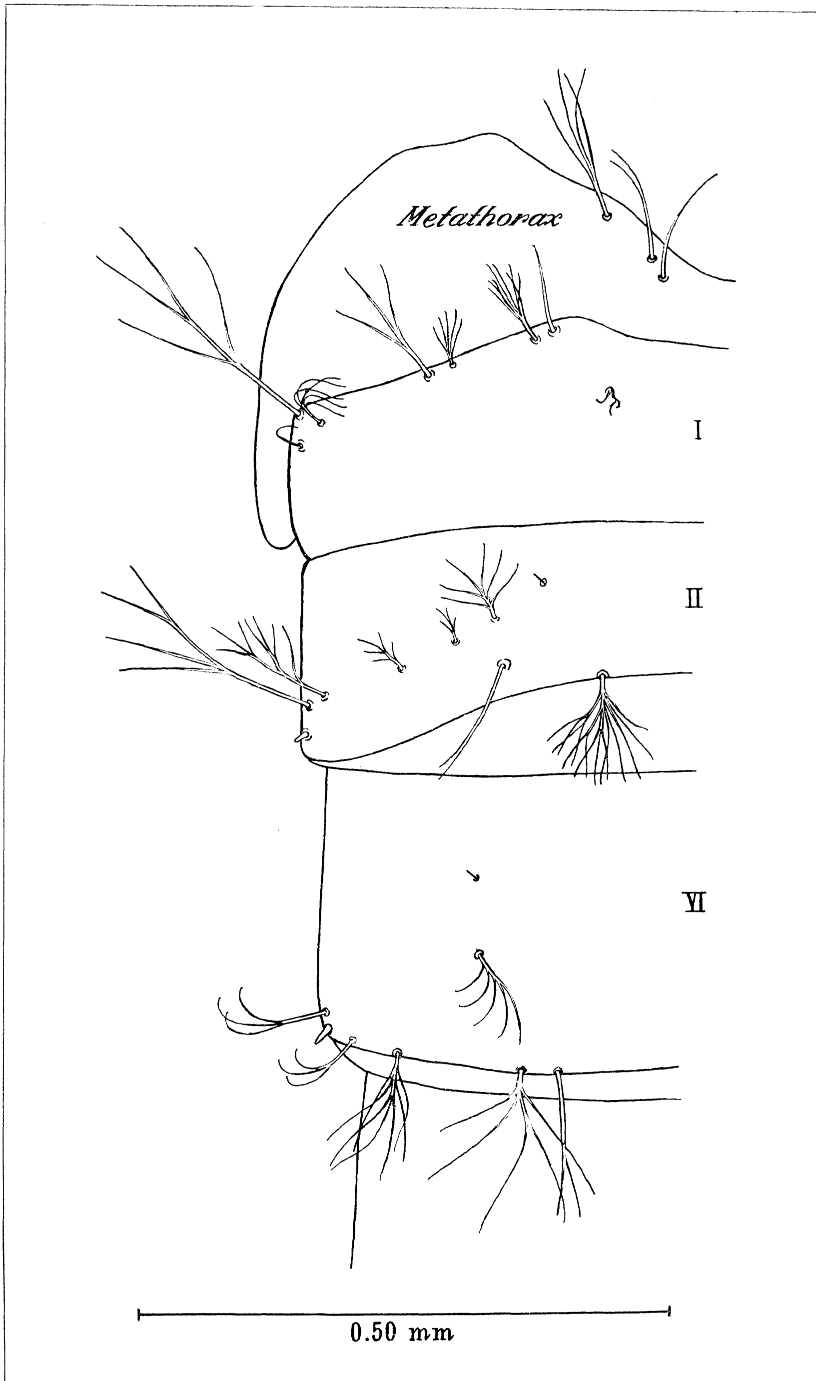


PLATE 21. ANOPHELES TESSELLATUS.

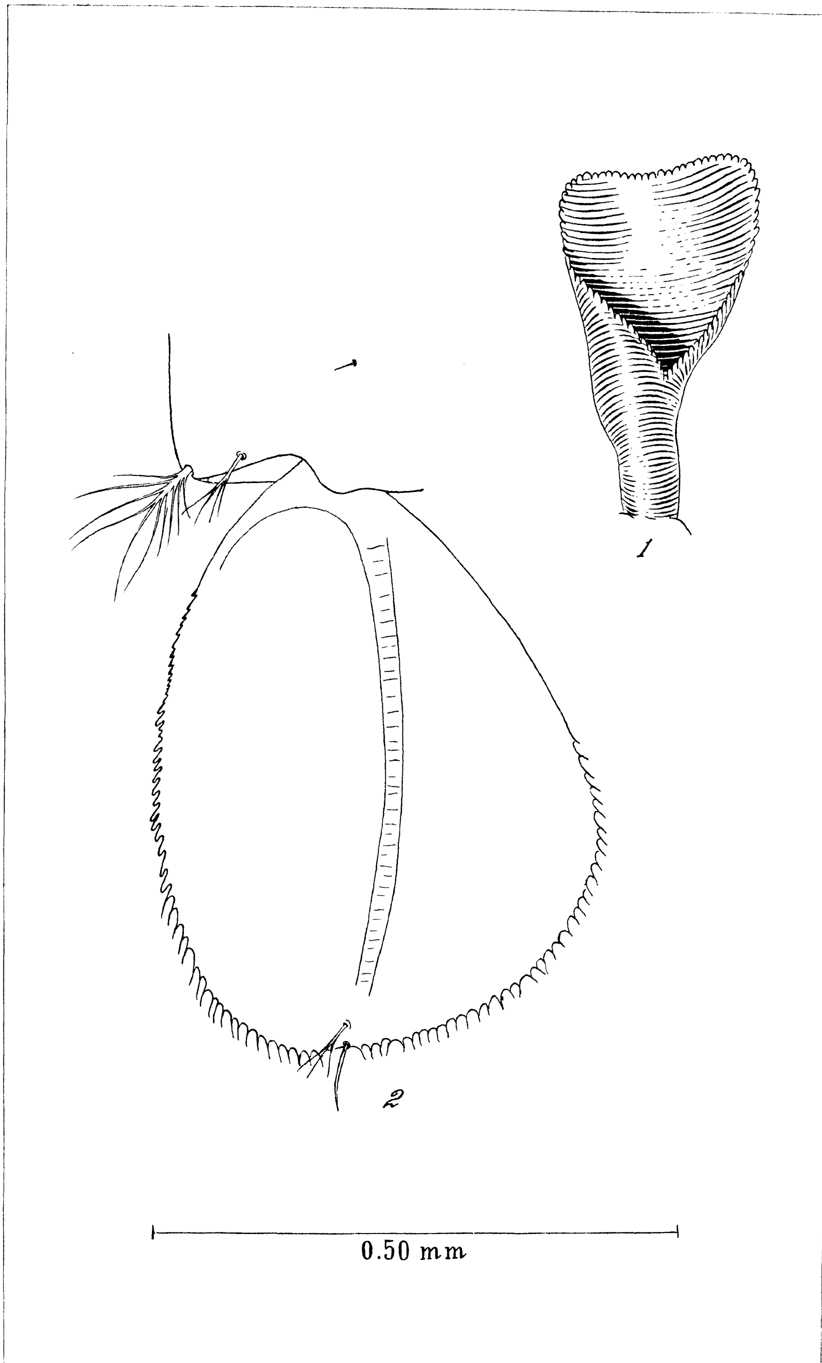


PLATE 22. ANOPHELES TESSELLATUS.

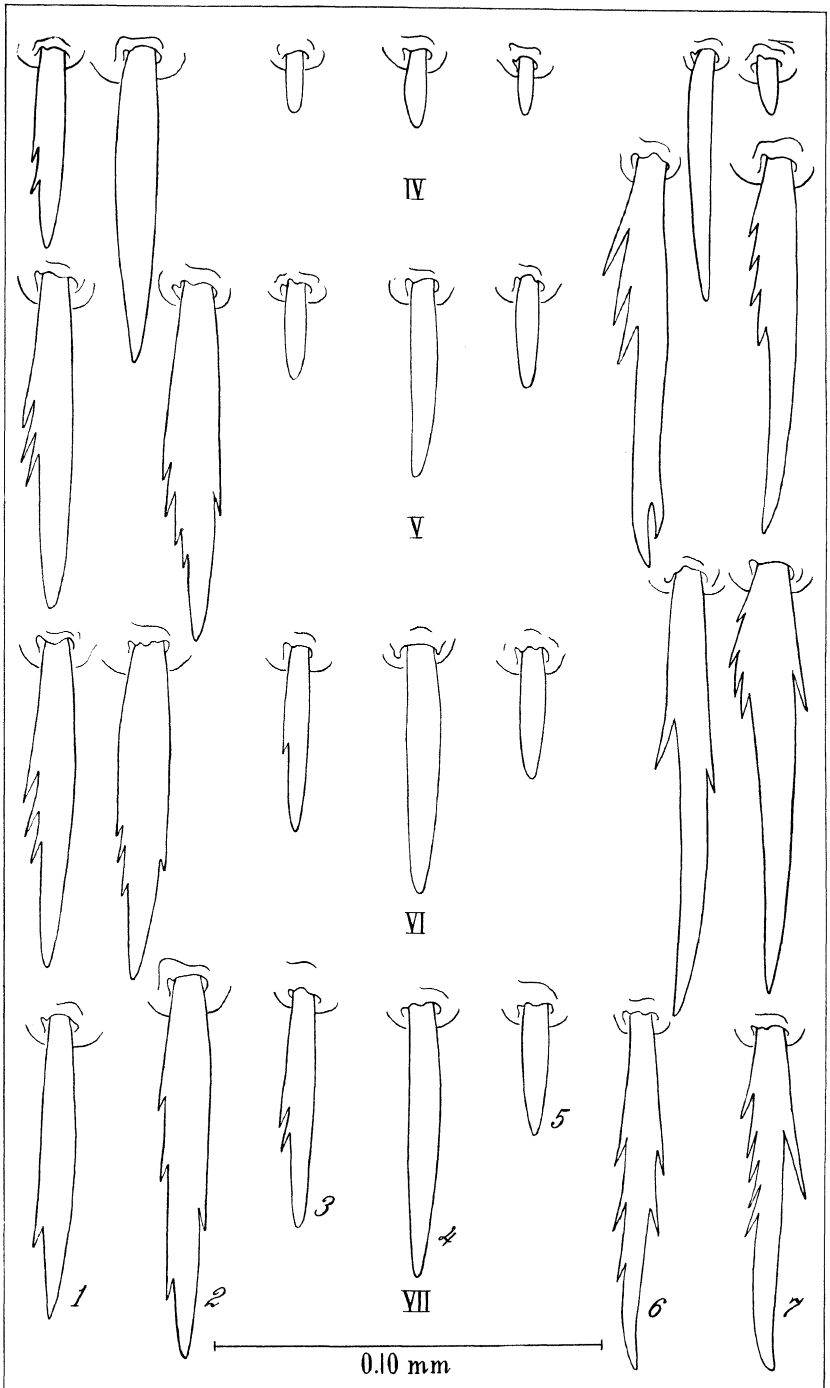


PLATE 23. PUPAL SPINES IV TO VII; GROUP NEOMYZOMYIA.

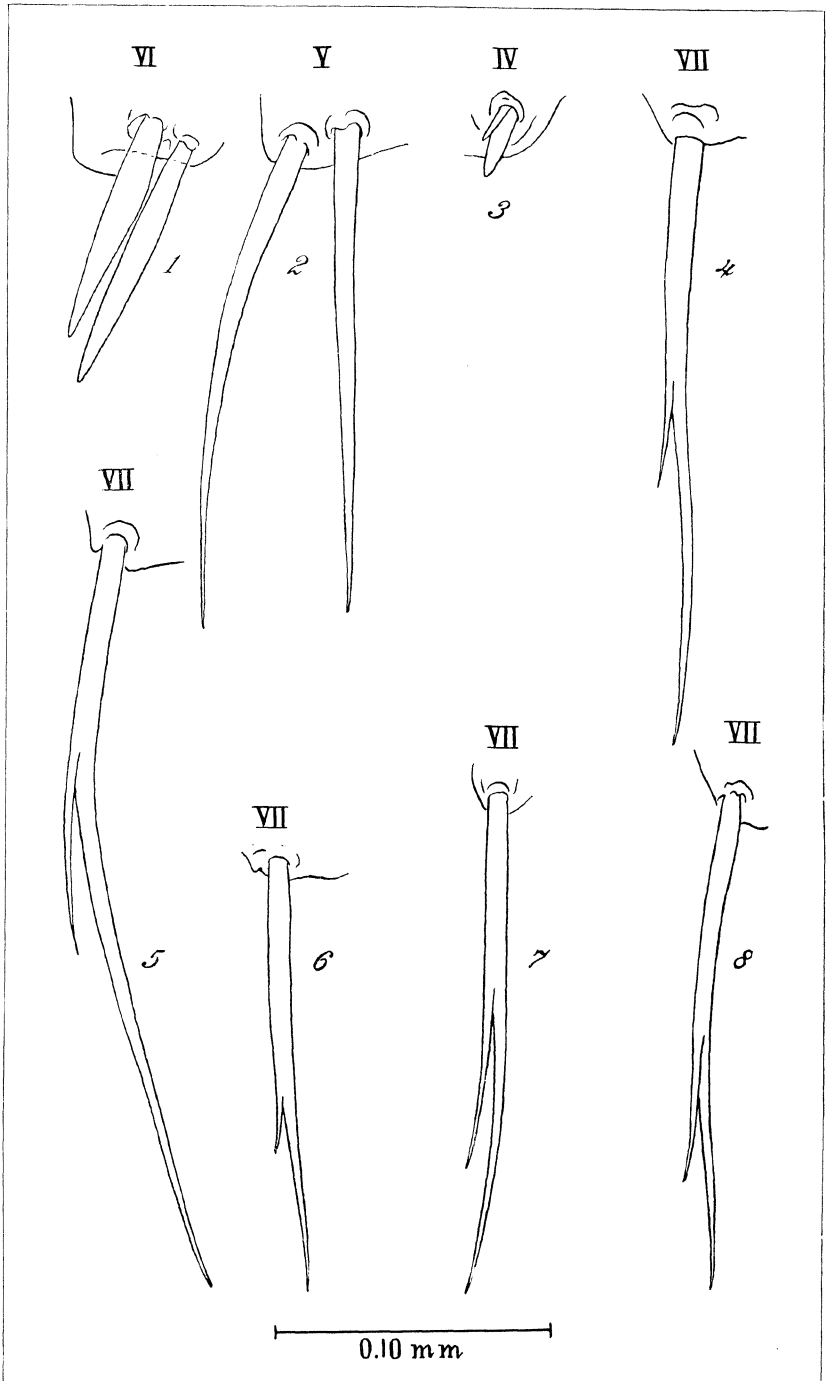


PLATE 24. DUPLICATION AND SPLITTING OF PUPAL SPINES.

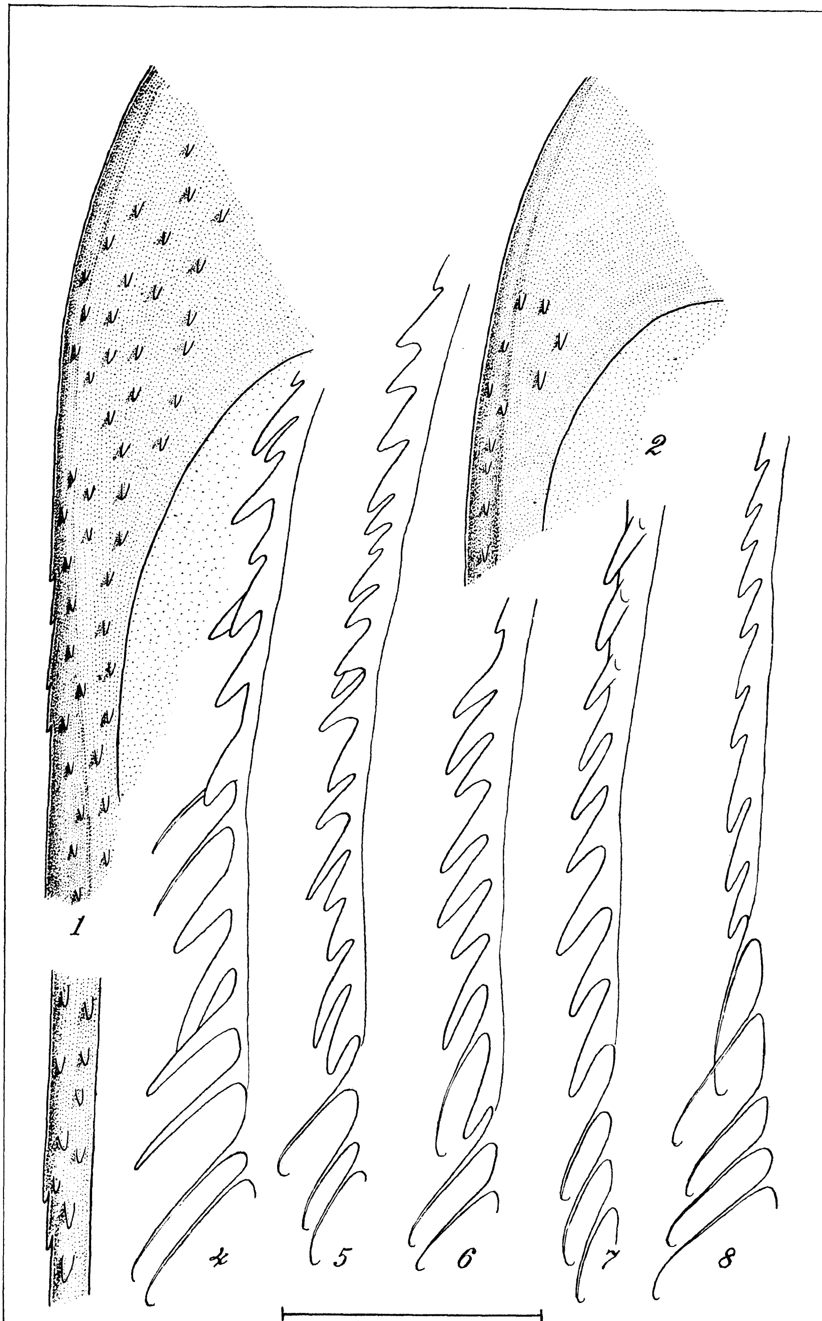


PLATE 25. DENTICLES AND ACCESSORY DENTICLES OF PADDLE; GROUP PSEUDOMYZOMYIA.

FURTHER OBSERVATIONS ON THE LIFE CYCLE OF GNATHOSTOMA SPINIGERUM [1]

By CANDIDO M. AFRICA, PEDRO G. REFUERZO, and EUSEBIO Y. GARCIA

Of the School of Hygiene and Public Health, University of the Philippines
Manila

In a recent study we (Africa, Refuerzo, and Garcia, 1936) reported the occurrence of encysted gnathostome larvæ (presumably of *G. spinigerum*) in the muscles of three species of fresh-water fishes (*Glossogobius giurus, Ophiocephalus striatus,* and *Therapon argenteus*), which when fed to white rats have been found to undergo development both in size and structure in the liver and skeletal muscles of these animals. We, therefore, advanced the tentative view that suitable and unsuitable hosts possibly get *Gnathostoma* infestations not by drinking water containing infected cyclopes as suggested by Prommas and Daengsvang (1933) following their success in infecting this crustacean with larvæ from hatched eggs of *G. spinigerum*, but by eating raw fresh-water fish containing encysted gnathostome larvæ. While we were putting our view to further experimental tests, on cats this time, Prommas and Daengsvang (1936) reported their successful experimental infection of *Clarias batrachus* (a fresh-water fish) with encysted gnathostome larvæ by feeding it with experimentally infected cyclopes. We are reporting here the results of our feeding of a cat with encysted gnathostome larvæ from naturally infested fish and our finding on six naturally infested aquatic snakes.

EXPERIMENT

Through the kindness of Dr. Marcos Tubangui, chief of the biological division of the Bureau of Science, Manila, we were able to obtain two adult cats which were reared from the litter under conditions that seem to preclude any possibility of their having contracted gnathostome infestation insofar as water and food or caging conditions were concerned. The two cats had

[1] Aided by a special research grant from the Board of Regents, University of the Philippines. Submitted for publication July 20, 1936.

never been given fish as part of their diet, and they had, as far as we are aware, absolutely no access to fish, accidentally or otherwise. One of the two cats was given per orem 4, 7, and 5 encysted gnathostome larvæ obtained from the flesh of *Glossogobius giurus* January 22, January 25, and February 14, 1936, respectively. The other cat was used as control. The two cats were placed in separate metal cages with screened floor far from other animals, and extreme precautions were taken to avoid giving them food or water other than those prescribed during the course of the experiment. Both cats were negative for helminth eggs at the start of our work.

About one and one-half months after the first feeding the droppings from the two cats were examined for gnathostome eggs from time to time, but both cats were consistently negative throughout the experiment. As we were getting impatient waiting for the appearance of the eggs and curious about the result of our feeding, we decided to sacrifice the experimental cat May 18, 1936, exactly 3 months 26 days after the first infection. On opening the stomach two nodules were found in the fundus; the larger one, which apparently had established a communication with the gastric lumen, contained two apparently mature gnathostomes (male and female); and the smaller nodule, which did not show any communication at all with the gastric cavity, contained one semimature worm. Two semimature worms were also found in the diaphragm. The intestines and other internal organs were free from infestation. The fæcal contents of the large intestine did not show the presence of eggs after repeated microscopic examination of concentrated samples.

The following are the measurements of the male and female worms recovered from the larger stomach nodule of our infested cat.

		Male.	Female.
Length	mm	12	14
Diameter	mm	0.612	0.75
Globular cephalic swelling	mm	0.512 x 0.230	0.50 x 0.250
Œsophagus	mm	2.2 x 0.525	0.30 x 0.625
Intestine, length	mm	7.6	8.00
Transverse rows of cephalic hooklets		8	11
Size of hooklets	mm	0.016 x 0.010	0.016 x 0.010

The anterior body spines are broad and have three, sharp, terminal points; the posterior body spines are narrow and have only one point. The number of rows of cephalic hooklets in the semimature worms obtained from the smaller stomach nodule and diaphragm varies from eight to nine.

The control cat was sacrificed May 25, 1935, and was found negative after an extensive search for evidence of infestation in the stomach, intestine, liver, muscles, and other internal organs.

GNATHOSTOME LARVÆ IN SNAKES

An opportunity to study gnathostome larvæ in reptiles was presented when six aquatic snakes, *Hurria rhynchops* (Schneider), were brought to our laboratory from Bulacan, a province near Manila. Dissection of these snakes revealed a large number of gnathostome larvæ (presumably of *G. spinigerum*) encysted in the mesentery and muscles immediately surrounding the parietal peritoneum. Some apparently semimature forms were also embedded just underneath the skin. The encysted larvæ have four transverse rows of cephalic hooklets and in size and structure resemble the ones found by us in the flesh of fresh-water fishes. The semimature ones found under the skin have from four to five transverse rows of cephalic hooklets and are considerably larger than the encysted ones. Because of the lack of available laboratory animals at the time the snakes were brought to us no feeding experiment was made, which we greatly deplore.

REMARKS

The two mature (male and female) worms obtained from a typical stomach nodule of our experimentally infested cat and the three semimature worms, one of which was also found in the stomach and the other two in the diaphragm, presumably resulted from our feeding of this animal with encysted larvæ of *Gnathostoma* from the flesh of *Glossogobius giurus* (a fresh-water fish), which together with *Ophiocephalus striatus* and *Therapon argenteus* (also fresh-water fishes) had previously been found naturally infested with these larvæ. The difficulty of finding cats that are absolutely free from infestation did not permit us to use a larger number of cats in this experiment, but we were satisfied by the assurance of Doctor Tubangui that

the two cats he gave us could be considered "clean" insofar as gnathostome infestation was concerned.

Morphologically the adult worms obtained from one of the stomach nodules answer faithfully the description of *G. spinigerum* even to the detail of the body spines as given by Faust (1929). The number of transverse rows of cephalic hooklets is 8 in the male and 11 in the female, a fact which confirmed the findings of Baylis and Lane (1920) that the number of transverse rows of cephalic hooklets in *Gnathostoma spinigerum* varies from 8 to 11. The five adult gnathostomes that we recovered from stomach nodules of naturally infested cats during our previous study of this subject all had 9 transverse rows of cephalic hooklets.

The absence of eggs in the fæces of our experimentally infested cat may merely indicate that oviposition had not yet commenced at the time our animal was sacrificed. Perhaps we could have recovered eggs in the fæces of this animal had we delayed our autopsy for a few weeks.

The consistent failure of Prommas and Daengsvang (1933 and 1936) to infect cats with cyclopes containing *G. spinigerum* larvæ from 7 to 30 days old, and their (1936) success in infecting a fresh-water fish (*Clarias batrachus*) with encysted larvæ by feeding it with experimentally infested cyclopes; our accidental finding of encysted gnathostome larvæ in the flesh of three species of fresh-water fishes under natural conditions; and finally, our successful infestation of a presumably "clean" cat with adult gnathostomes occurring in a typical stomach nodule by feeding this animal with encysted larvæ from naturally infested *Glossogobius giurus*, all seem to point definitely to the fact that gnathostomes require in their life cycle a second intermediate host in the form of a fresh-water fish.

Our finding of gnathostome larvæ apparently of two distinct groups with regard to size and degree of development in *Hurria rhynchops* (Schneider) has developed a peculiar situation insofar as snakes are concerned in the life cycle of *G. spinigerum*. In our first paper on this subject (Africa, Refuerzo, and Garcia, 1936) we remarked that the fact that the larvæ which Chandler (1925) recovered from snakes approximate both in size and structure the encysted larvæ from the flesh of fishes would imply that the snakes act in the same capacity as the fishes, which even at that time we already believed to be the second intermediate host of *G. spinigerum*. On the other hand, we mentioned the possibility of the snakes assuming the

rôle of the so-called unsuitable host of this nematode; that is, one that would allow the development of the worm only up to a certain stage short of maturity and not become a second intermediate host.

SUMMARY

A cat, presumably free from previous infestation of *G. spinigerum,* has been successfully infested with this gnathostome by feeding it with encysted larvæ from a naturally infested *G. giurus* (a fresh-water fish). This result tends to confirm the view we advanced in a previous work (Africa, Refuerzo, and Garcia, 1936) that suitable and unsuitable hosts of *G. spinigerum* possibly get their infestation not by drinking water containing infected cyclopes, but by eating infested fresh-water fishes which in turn have eaten infected cyclopes.

Our finding of two apparently different groups of gnathostome larvæ in *Hurria rhynchops* (Schneider), an aquatic snake, indicates that the possible rôle of snakes in the life cycle of *G. spinigerum* needs further study.

REFERENCES

AFRICA, C. M., P. G. REFUERZO, and E. Y. GARCIA. Observations on the life cycle of Gnathostoma spinigerum. Philip. Journ. Sci. **59** (1936) 513–523.

BAYLIS, H. A., and C. LANE. A revision of the nematode family Gnathostomatidæ. Proc. Zool. Soc. London 2 (1920) 245–310.

CHANDLER, A. C. A contribution to the life history of a gnathostome. Parasit. 17 (1925) 237–244.

FAUST, E. C. Human Helminthology. Lea and Febiger, Philadelphia (1929).

PROMMAS, C., and S. DAENGSVANG. Preliminary report of a study on the life cycle of Gnathostoma spinigerum. Journ. Parasit. **19** (1933) 287–292.

PROMMAS, C., and S. DAENGSVANG. Further report of a study on the life cycle of Gnathostoma spinigerum. Journ. Parasit. 22 (1936) 180–186.

SOMATIC HETEROPHYIDIASIS IN FISH-EATING BIRDS, II

PRESENCE OF ADULTS AND EGGS IN THE BILE DUCTS OF THE CATTLE EGRET [1]

By CANDIDO M. AFRICA, WALFRIDO DE LEON, and EUSEBIO Y. GARCIA
Of the School of Hygiene and Public Health, University of the Philippines Manila

TWO PLATES

As we were curious to know if *Monorchotrema taihokui* and *M. taichui* show the same proclivity to invade the internal organs in their bird host as they do in man(1, 2, 3, 4) and encouraged by our success in finding what appears to be an extension of *Stictodora* infestation from the small intestine to the pancreas in a sea gull (*Larus ridibundus* Linn.),(5) we examined a large number of cattle egrets (*Bubulcus ibis coromandus* Boddaert), which we previously found to harbor both these heterophyids in the small intestine, and discovered large concentrations of eggs (presumably of these flukes) as well as adult parasites in the bile ducts of three of the twenty-seven birds dissected. Fifteen of the egrets showed the presence of one or both of these heterophyids in the small intestines, an incidence of 55.4 per cent. No evidence of extension of the infestation was found in the following organs: Pancreas, spleen, heart, kidneys, and lungs. This report deals chiefly with our findings in the liver of this bird.

TECHNIC AND MATERIALS

The twenty-seven egrets examined in this work were bought from a dealer who caught them at different points along the shore of Laguna de Bay, a fresh-water lake about 25 kilometers south of Manila, Luzon. The technic we followed in this investigation is more or less similar to the one we adopted in our investigation in human heterophyidiasis,(4) and hence will not be redescribed here. After determining the presence of

[1] Aided by a special research grant from the Board of Regents, University of the Philippines.

either one or both of these heterophyids in the small intestine of this bird, the liver, pancreas, kidneys, heart, lungs, and spleen were isolated, removed, and preserved. Multiple blocks were cut from each of the above-mentioned organs for serial sectioning. It is felt that each of the organs mentioned above has been sufficiently covered or explored in each bird for the purpose of this work.

DESCRIPTION OF THE LESIONS

In this paper we are limiting ourselves to the consideration of the liver alone since no evidence of the extension of the infestation to the other organs has been found.

Grossly the infested liver does not show any abnormality that would differentiate it from the uninfected one. Except in portal areas that happen to contain collections of heterophyid eggs or, occasionally, what appear to be adult flukes or remnants of them, even the examination of histological sections has failed to reveal any marked abnormality other than evidence of mild degenerative changes due to pressure observed here and there in the parenchymatous areas. Actual hæmorrhage or any recent or remote indication of it is conspicuously lacking. The parasites are confined within the portal area, invariably in the immediate vicinity of the portal vessels; no evidence of their presence is found in other areas. This finding suggests that the flukes probably arrived in the liver from the intestine by way of the bile passages. Whenever the fluke or flukes show long residence in the locality as indicated by the complete disappearance of any remnants of them except their eggs, a definite chronic inflammatory reaction in the form of a fibrotic capsule with leucocytic infiltration, mostly of the round-cell variety, is observed around the parasites. Eosinophiles are conspicuously absent. Scattered here and there along this fibrotic wall, mostly on the outside, are islets of bile epithelium, indicating attempts at regeneration of the destroyed bile ducts. Within the fibrotic capsule and in direct contact with the egg collection are numerous endothelial cells, some of which have fused to form giant cells. The flukes that have just arrived in the bile ducts, as indicated by beautifully stained reproductive glands and well-stained miracidia within their eggs, are not surrounded by any marked cellular reaction, except that the bile duct containing the parasite is greatly dilated, the epithelium is obliterated, and there is a very scanty fibrotic formation which is devoid of any leucocytic infiltration. The sheets or masses of

cells of the type we found in vascular lesions primarily caused by heterophyid eggs in human cardiac and cerebral heterophyidiasis,(2, 3, 4,) as well as in heterophyid infestation in the pancreas of a sea gull (*Larus ridibundus*),(5) have not been observed in any of the sections in the present material.

DISCUSSION

The evidence we have gathered in this paper tends to show that *Monorchotrema taihokui* and *M. taichui* do not behave in the bird as they do in their human host. The tendency to invade the general circulation and consequently internal organs quite remote from their intestinal habitat which we have observed recently in human infestations with these flukes,(1, 2, 3, 4) appears to be absent in their avian host. At least insofar as the cattle egret is concerned, the farthest organ from the intestine they have reached is the liver, which they seem to invade not through the agency of the blood circulation but through the bile passages. That this tendency to invade the bile ducts seems to be rather unusual in the avian host is indicated by the fact that of fifteen birds positive for either *M. taichui* or *M. taihokui*, or both, only three showed flukes or evidence of their presence in the liver.

This finding raises the question as to whether the cattle egret is the normal host of these heterophyids. The term normal host (used here advisedly) implies an animal which allows a parasite to run a normal course of parasitic existence conducive to its proper propagation and well-being and which on the other hand suffers a minimum of damage in doing so. This necessarily involves a state of adaptation between the host and the parasite which is gradually developed in proportion to the length of time of their parasitic association, the tendency being to arrive at a condition of perfect adjustment between parasite and host. That the adjustment between these *Monorchotrema* spp. and their human host is not as good as that which they enjoy in their avian host would appear from the fact that we frequently found the eggs of these heterophyids in the fæces of infected birds without the use of any special technic other than ordinary fæcal-smear examination, a thing which we were not able to do in human heterophyid infestation even in cases where adult flukes were recovered in the intestinal scrapings.

The parasitic relationship between these heterophyids and their avian host appears to be more balanced and, therefore, more conducive to a normal parasitic existence. In other words

a parasitic relationship wherein a condition of "live and let live" is attained appears to have been developed after long and continuous contact between *M. taihokui* and *M. taichui* on the one hand and the cattle egret (*Bubulcus ibis coromandus*) on the other. These heterophyids do not seem to have the tendency to invade the circulation in their bird host, and although some of them may wander to the bile passages of the liver, this migration does not seem to be a usual or normal occurrence, as has been pointed out above. Those flukes that happen to be in the bile ducts seem to produce too little damage to endanger the life of the host. For this reason we feel inclined to hold the view that this cattle egret permits normal parasitic development of these heterophyids and acts as one of the reservoir hosts whose droppings pollute the water where the appropriate snail host may be found. This view is supported by our finding of the metacercaria of *M. taihokui* in two species of fresh-water fishes (*Arius manilensis*, "kanduli;" and *Clarias batrachus*, "hito") in Laguna de Bay, along the shore of which this bird abounds. In this connection it may be of interest to note that a human infestation with *M. taihokui* with myocardial complication has been reported by Africa, de Leon, and Garcia(4) from Biñan, a town on the shore of the above-mentioned lake.

On the other hand, as a result of an unbalanced parasitic relationship that seems to exist between these heterophyids and their human host, these flukes, as shown in our previous publications, seem to have the tendency to penetrate far into the deeper layers of the wall of the small intestine after excystment and therein to die, disintegrate, and give up their eggs, which are later absorbed by the blood stream and deposited in remote organs of the body. In this manner these flukes not only tend to shorten the life of their human host, but also lose their opportunity to expel their eggs through natural and proper channels. This fact perhaps explains the apparent absence of their eggs in the fæces of infested persons. Such a condition is far from being conducive to successful parasitism, which consists chiefly in the ability of the parasites to do the least damage possible to their host and at the same time live, reproduce, and provide natural exit for their young in order to reach new hosts for the perpetuation of their kind.

The present finding in the cattle egret is quite analogous to what we(5) have observed in a sea gull (*Larus ridibundus*), in the pancreas of which we found numerous huge collections of eggs, presumably of *Stictodora* spp., which occurred in large

numbers in the small intestine of this bird. The small number of birds examined in this work does not warrant the assumption that these species of heterophyids confine their migration to the pancreas in this bird, for further dissection may reveal their presence in other organs also, especially the liver. Evidence gathered so far seems to show that in *Stictodora* infestation the invasion of the pancreas is by way of the pancreatic duct, even as the invasion of the liver in the *Monorchotrema* spp. infestation is through the bile duct. In the event that these two groups of heterophyids are finally proven to have a specific affinity for the respective organs mentioned above, an inexplicable phenomenon, analogous to the specific affinity of the three human schistosomes for the different tributaries of the portal vein, will be established since the bile duct and the pancreatic duct have a common stem from the intestinal lumen.

SUMMARY

Of twenty-seven cattle egrets (*Bubulcus ibis coromandus* Boddaert) examined fifteen showed the presence of either *Monorchotrema taihokui* or *M. taichui*, or both, in the small intestine, and three of the infested birds showed extension of the infestation to the bile ducts of the liver, but none in other internal organs. The flukes appear to have invaded the liver through the bile ducts, there being neither evidence of vascular disturbances in the infested organ nor signs of the presence of flukes or their remnants in areas other than the immediate vicinity of the portal vessels. The lesions found consist of chronic inflammatory reaction in the form of fibrotic capsules with leucocytic infiltrations, mostly of the round-cell variety, surrounding the parasites, and hyperplastic changes of the bile ducts. The hostal relations of *M. taihokui* and *M. taichui* with their human and avian hosts are discussed, and the possibility of the cattle egret acting as a reservoir host of these heterophyids is suggested.

BIBLIOGRAPHY

1. AFRICA, C. M., E. Y. GARCIA, and W. DE LEON. Intestinal heterophyidiasis with cardiac involvement: A contribution to the etiology of heart failures. Philip. Journ. Pub. Health 2 Nos. 1 and 2 (March–June, 1935).
2. AFRICA, C. M., W. DE LEON, and E. Y. GARCIA. Heterophyidiasis: II, Presence of ova in sclerosed mitral valves including other chronic lesions in the myocardium. Journ. Philip. Is. Med. Assoc. 15 (November, 1935) 583–592.

3. AFRICA, C. M., W. DE LEON, and E. Y. GARCIA. Heterophyidiasis: III, Ova associated with a fatal hemorrhage in the right basal ganglia of the brain. Journ. Philip. Is. Med. Assoc. **16** (January, 1936) 22–26.
4. AFRICA, C. M., W. DE LEON, and E. Y. GARCIA. Heterophyidiasis: IV, Lesions found in the myocardium of eleven infested hearts including three cases with valvular involvement. Philip. Journ. Pub. Health **3** Nos. 1 and 2 (March–June, 1936).
5. AFRICA, C. M., W. DE LEON, and E. Y. GARCIA. Somatic heterophyidiasis in fish-eating birds: I, Ova associated with chronic lesions in the pancreas of a sea-gull (Larus ridibundus Linn.). Philip. Journ. Pub. Health **3** Nos. 1 and 2 (March–June, 1936).

ILLUSTRATIONS

Plate 1

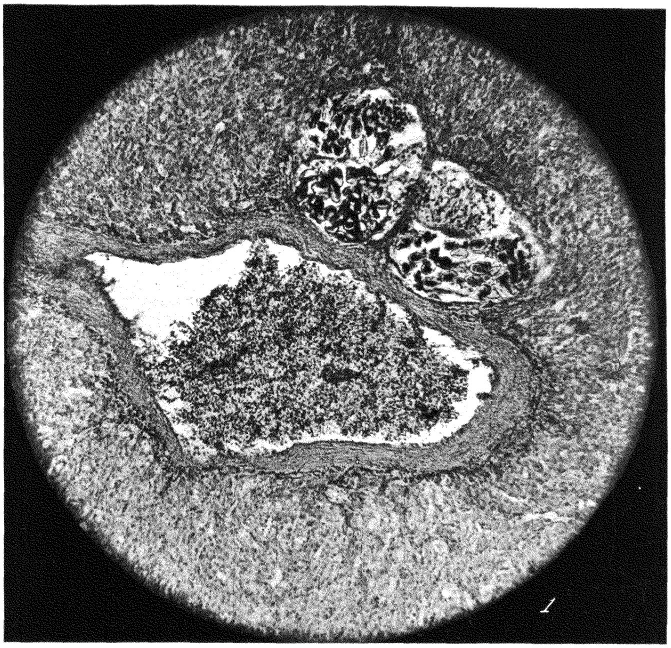
Fig. 1. Photomicrograph (low power) of a section of the liver of a cattle egret (*Bubulcus ibis coromandus* Boddaert) showing transverse sections of two flukes in a greatly dilated bile duct. Note the scanty fibrotic capsule around the parasites.

2. Photomicrograph (low power) of another section of the same liver showing a collection of eggs surrounded by a thick fibrotic capsule with leucocytic infiltration mostly of the round-cell variety. Note (*a*) hyperplastic bile ducts, (*b*) giant cells, (*c*) portal vein.

Plate 2

Fig. 1. The same section as in Plate 1, fig. 1, under high magnification.

2. The same section as in Plate 1, fig. 2, under high magnification, showing the character of the fibrotic capsule surrounding the empty eggs and the giant cells trying to engulf the eggs at the periphery of the collection.



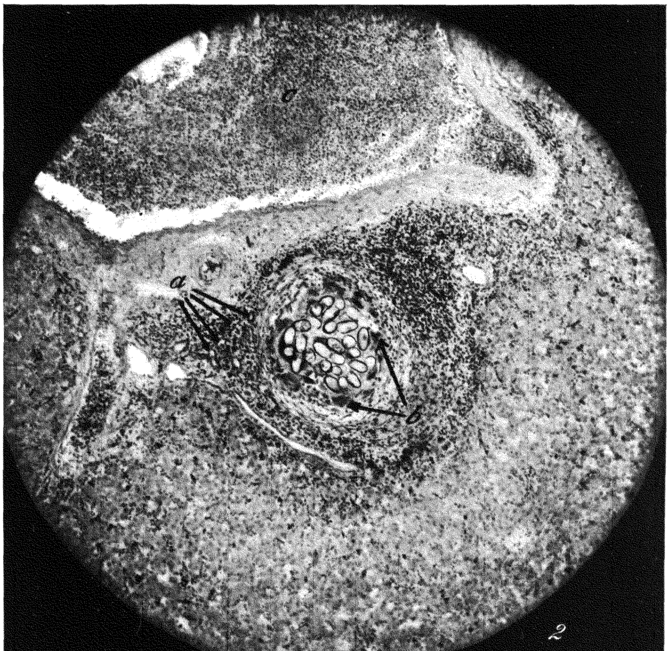


PLATE 1.

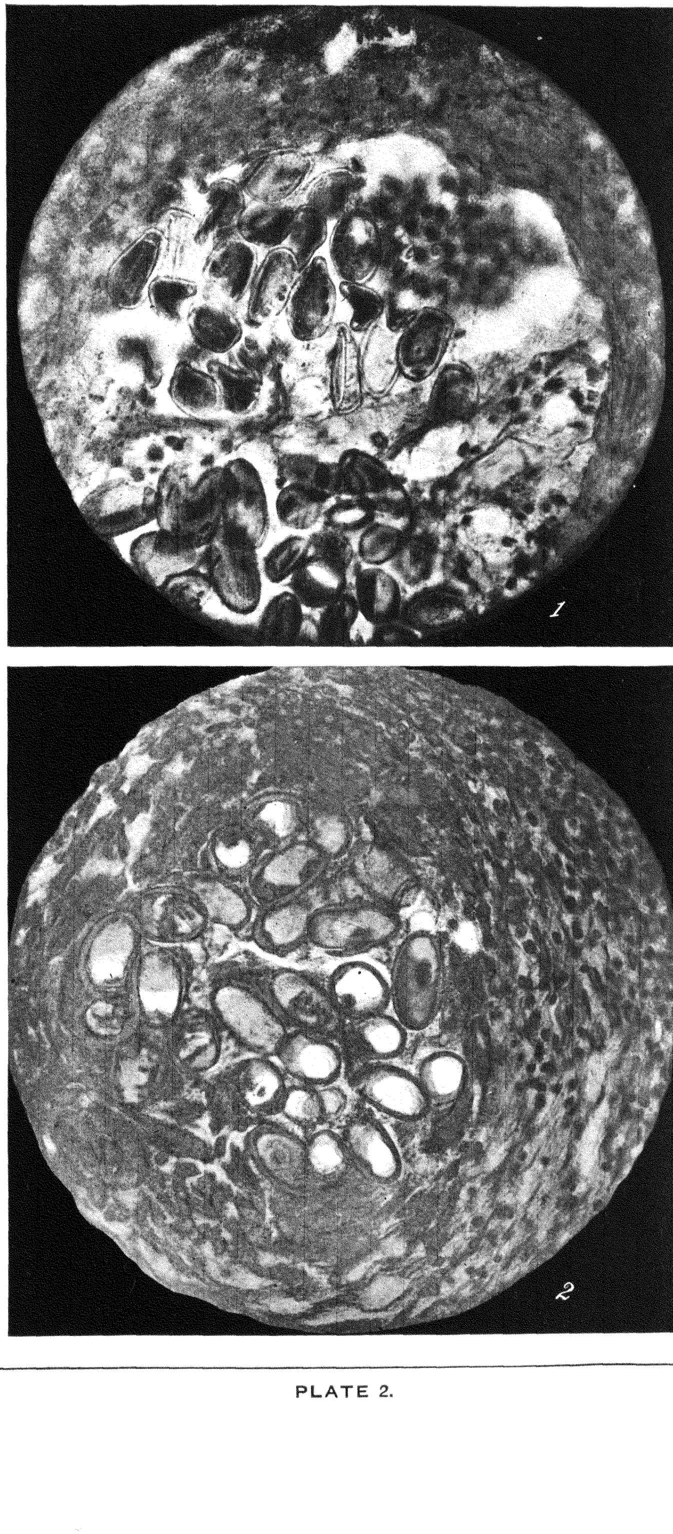


PLATE 2.

BORNEAN MOSSES, PRINCIPALLY FROM MOUNT KINABALU

By EDWIN B. BARTRAM

Of Bushkill, Pike County, Pennsylvania

ONE PLATE

During the latter part of 1933 Mr. and Mrs. Joseph Clemens actively collected mosses in the Kinabalu region, Borneo, at altitudes between 3,500 and 12,500 feet. The details of this collection can now be recorded without fear of duplicating any of the new species included in Dixon's important paper.[1]

The presence of five new species and three new varieties in addition to eighteen species not previously known from Borneo emphasizes again the almost inexhaustible riches of this tropical flora.

An especially interesting isolated group from the higher elevations of Kinabalu up to 12,500 feet includes *Andreaea petrophila* var. *rubicunda*, *Grimmia ovalis*, and *Rhacomitrium crispulum*, all of them new to Borneo and showing a wide break in geographic distribution. Further explorations of this high granite dome will probably reveal more species of the affinities.

Included in the list are a few collections by E. Mjoberg from Mount Tibang, located near the junction of the Kapuas and Iran Mountain Ranges in the upper center of the island, which came from the Farlow herbarium.

Unless otherwise indicated the collections listed below are by J. and M. S. Clemens from Mount Kinabalu.

ANDREAEACEÆ

ANDREAEA PETROPHILA Ehrh. var. RUBICUNDA var. nov.

Folia conferta, sicca suberecta, saepe rotundato-obtusa, intense rubra.

BORNEO, Gurulau Spur, base of Victoria Peak, on granite slope, elevation 12,500 feet, *Clemens s. n.*

A significant range extension of this species as broadly interpreted, and a suggestive addition to the Bornean flora indicating a closer bond with the Himalaya region than with any other.

[1] Linn. Soc. Journ. 1 (1935) 57–140.

FISSIDENTACEÆ

FISSIDENS ASPLENIOIDES Hedw.

On rock near Dehobang Falls, Penibukan, elevation 5,000 feet, *Clemens 40290d.*

New to Borneo. The nearest records for this species are from Java and Sumatra.

DITRICHACEÆ

DITRICHUM FLEXIFOLIUM (Hook.) Hpe.

Gurulau Spur, elevation 10,000 feet, on rocks, north of Paka, Kadamian River, head of low jungle; Gurulau Spur, base of Victoria Peak, elevation 12,500 feet, on granite slope.

DICRANACEÆ

DICRANELLA SETIFERA (Mitt.) Jaeg.

Tenompok, yellow soil in damp exposed place, elevation 5,000 feet.

CAMPYLOPUS HEMITRICHIUS (C. M.) Jaeg.

Pinokkok Falls, elevation 6,500 feet, on wet rocks; Penibukan, on wet rocks near Pinokkok Falls, elevation 6,500 feet, *Clemens 40975a.*

New to Borneo. Previously known only from the Philippines.

CAMPYLOPUS UMBELLATUS (W. Arn.) Bartr.

Masilan River, elevation 6,000 feet, *Clemens 51378;* Gurulau Spur, elevation 8,000 feet, on rocks in stream bed, *Clemens 51211;* Gurulau Kamboranga, elevation 8,000 feet; Tenompok, damp rock, elevation 5,000 feet.

CAMPYLOPUS EXASPERATUS Brid.

Gurulau Spur, elevation 7,000 to 8,000 feet, *Clemens 51444;* South Gurulau Spur, elevation 7,000 to 8,000 feet, on trunks, logs, etc., *Clemens 51666;* jungle trail below Gurulau Kamboranga, on trees, elevation 6,000 to 8,000 feet, *Clemens 51047a;* Masilan, near ford, elevation 7,000 feet, *Clemens 51654a;* Gurulau Spur, near Gurulau Kamboranga, elevation 8,000 to 9,000 feet, *Clemens 50838b;* Penibukan, near Pinokkok Falls, elevation 6,500 feet, *Clemens 40975;* Gurulau Spur, margin of recent landslide, North Paka and Kadamian River, elevation 10,500 feet, *Clemens 50885.*

DICRANODONTIUM NITIDUM Fleisch. var. CLEMENSIAE var. nov.

Cellulae basilares chlorophyllosae magis fortiter porosae.

BORNEO, Mount Kinabalu, Gurulau Spur, elevation 7,000 to 8,000 feet, in dense masses on trail and trees, *Clemens 51029*

type, *51438;* Gurulau Spur, elevation 7,000 to 8,000 feet, mossy forest dripping, *Clemens 51030;* jungle trail below Gurulau Kamboranga, on trees, elevation 6,000 to 8,000 feet, *Clemens 51047b;* Gurulau Spur, jungle trail below Gurulau Lobang and Kamboranga, *Clemens 51045.*

This seems to be a well-marked variant and is possibly the form noted by Dixon.[2] The leaves in the specimens noted here are, however, if anything, wider than usual towards the base; the area of clear rectangular cells is sharply defined from the very narrow marginal cells of the leaf base and grades abruptly into the chlorophyllose cells above, which are very incrassate with strongly porose pellucid lateral walls.

HOLOMITRIUM VAGINATUM (Hook.) Brid.

Penibukan Ridge, elevation 4,000 feet, on forest tree, *Clemens 40431.*

New to Borneo. Distribution: Java, Philippines, Pacific Islands.

DICRANOLOMA SUBECOSTATUM Dix.

Dicranoloma subenerve Broth.

Gurulau Spur, elevation 7,000 to 8,000 feet, on trees and ground, *Clemens 51100, 51034, 51445.*

DICRANOLOMA BREVISETUM (Doz. and Molk.) Par.

Penibukan, elevation 4,000 feet, ridge east of Dahobang River, on tree, *Clemens 50121.*

DICRANOLOMA BLUMII (Nees) Par.

Gurulau Spur, elevation 7,000 to 8,000 feet, *Clemens 51437, 51445a.*

DICRANOLOMA ANGUSTIFRONDEUM Dix.

Tenompok, elevation 5,000 feet, on dead log; Columbon River basin, on tree, bank above stream, elevation 4,500 feet.

DICRANOLOMA EURYLOMA Dix. var. RUGIFOLIUM var. nov.

Mount Tibang, elevation 1,600 m, *Mjoberg s. n.,* November, 1925.

Very close to *D. euryloma* and, in fact, inseparable except by the undulate leaves which give the plants a characteristic look. The subula varies considerably in length and the hyaline border in width, but no more so than in typical plants that I owe to the kindness of Mr. Dixon. The leaf cells are quite

[2] Op. cit. 72.

thin and poorly defined. The walls are relatively wide but of the same color as the lumens and hence quite indistinct.

LEUCOLOMA MOLLE (C. M.) Mitt.

Jungle ridge near Dahobang River, elevation 3,500 feet, *Clemens 40594d;* Penibukan, ridge below camp, on branch, elevation 3,500 feet, *Clemens 50053c.*

BRAUNFELSIA SCARIOSA (Wils.) Par.

Masilan River, elevation 6,000 feet, *Clemens 51380a, 51486;* Gurulau Spur, elevation 7,000 to 8,000 feet, *Clemens 51440;* Penibukan, near Pinokkok Falls, on rocks, wet jungle, elevation 6,000 feet, *Clemens 40934b.*

BRAUNFELSIA PLICATA (Lac.) Fleisch.

Penibukan, near Pinokkok Falls, on rocks, wet jungle, elevation 6,000 feet, *Clemens 40934a.*

LEUCOBRYACEÆ

LEUCOBRYUM SANCTUM Hpe.

Mount Tibang, elevation 1,400 m, *Mjoberg s. n.,* November, 1925.

LEUCOBRYUM TEYSMANNIANUM Doz. and Molk.

Penibukan, on log in jungle, elevation 4,500 feet, *Clemens 40713b.*

LEUCOBRYUM JAVANENSE (Brid.) Mitt.

Penibukan Ridge, on log, elevation 3,600 feet, *Clemens 40945c.*

LEUCOBRYUM PULCHRUM Broth.

Gurulau Spur, elevation 7,000 to 8,000 feet, mossy forest, on earth, *Clemens 51031.*

CLADOPODANTHUS PILIFER Doz. and Molk.

Jungle ridge above camp, on tree, elevation 4,500 feet, *Clemens 50305b;* Penibukan, elevation 4,000 feet, on twigs of tree, *Clemens 40531a.*

These specimens are meager, just a few plants in each case segregated from other mosses, but enough for identification.

New to Borneo. Distribution: Java.

CLADOPODANTHUS SPECIOSUS (Doz. and Molk.) Fleisch.

Penibukan, elevation 6,000 feet, near Pinokkok Falls, on rocks, wet jungle, *Clemens 50280;* Penibukan, elevation 5,000 feet, west ridge, jungle, *Clemens 50280.*

EXODICTYON BLUMII (C. M.) Fleisch.

Penibukan, elevation 4,000 feet, between flanges of 250-foot tree, *Clemens 40658a.*

LEUCOPHANES CANDIDUM (Hornsch.) Lindb.

Penibukan, jungle ridge near Dahobang River, elevation 3,500 feet, *Clemens 40594e.*

CALYMPERACEÆ

SYRRHOPODON TRISTICHUS Nees.

Penibukan, wall by side of Pinokkok Falls, elevation 6,500 feet, *Clemens 40899a.*

SYRRHOPODON GARDNERI (Hook.) Schwaegr.

Jungle Spur, on bark of great tree, elevation 5,000 feet, *Clemens 50477a.*

THYRIDIUM JUNGQULIAN (Mitt.) Jaeg.

Penibukan, ridge below camp, elevation 3,500 to 4,000 feet, *Clemens 40431b, 50053b.*

POTTIACEÆ

WEISIA CONTROVERSA Hedw.

Damp places, elevation 3,500 feet.

New to Borneo. Distribution: Cosmopolitan.

BARBULA JAVANICA Doz. and Molk.

Penibukan, on rocks near Dahobang Falls, elevation 5,000 feet, *Clemens 40290b.*

New to Borneo. Distribution: Himalayas, Java, Sumatra, Celebes, Philippines.

GRIMMIACEÆ

GRIMMIA OVALIS (Hedw.) Lindb.

Gurulau Spur, base of Victoria Peak, elevation 12,500 feet, on granite slope, *Clemens 51517b.*

New to Borneo. Distribution wide in temperate regions and at high altitudes in the Tropics, but not recorded from Malaysia as far as I know.

RHACOMITRIUM CRISPULUM (H. f. and W.) H. f. and W.

Gurulau Spur, base of Victoria Peak, elevation 12,500 feet, on granite slope, *Clemens 51517.*

New to Borneo. Distribution: Fuegia, New Zealand.

These plants seem to represent one of the forms of this protean species with the leaves merely acute and lacking any

trace of a hair point. It is a wide extension in the geographic range of the species, but I can find no character of any importance by which it might be separated.

RHACOMITRIUM JAVANICUM Bryol. Jav.

Masilan River, on stones, forest, elevation 5,000 to 7,000 feet, unexplored region, *Clemens 51664*.

FUNARIACEÆ

FUNARIA CALVESCENS Schwaegr.

Masilan River, elevation 7,000 to 9,000 feet, near lobang, *Clemens 51282*.

BRYACEÆ

BRACHYMENIUM NEPALENSE Hook.

Gurulau Spur, jungle spur, on great tree near camp, elevation 5,000 feet, *Clemens 50479;* Masilan River, elevation 6,000 feet, *Clemens 51380;* Pinokkok Falls, on limb.

BRYUM NITENS Hook.

Penibukan, on rock near Dahobang Falls, elevation 5,000 feet, *Clemens 40290f*.

New to Borneo. Distribution: Nepal, Ceylon, Java.

RHODOBRYUM GIGANTEUM (Hook.) Par.

Head of Columbon River, elevation 5,000 to 7,000 feet, mossy forest.

MNIACEÆ

MNIUM ROSTRATUM Schrad.

Head of Columbon River, mossy forest, Keebamban River, elevation 5,000 to 6,000 feet; Masilan River, near lobang, elevation 6,000 feet, *Clemens 51283a*.

RHIZOGONIACEÆ

RHIZOGONIUM SPINIFORME (Hedw.) Bruch.

Numerous collections; from 3,500 to 6,500 feet elevation.

HYPNODENDRACEÆ

HYPNODENDRON BECCARII (Hpe.) Jaeg.

Penibukan, ridge, jungle log, elevation 4,500 feet, *Clemens 40557a;* Penibukan, ridge east of Dahobang River, elevation 4,000 feet, *Clemens 50075;* Columbon River basin, on tree, bank

above stream, elevation 4,500 feet, *Clemens 33923;* Tenompok, elevation 5,000 feet, on damp logs.

These collections are richly fruited and show the characteristic orange coloration and the smooth capsules mentioned by Dixon.

MNIODENDRON DIVARICATUM (Hornsch. and Reinw.) Lindb.

Penibukan, elevation 4,500 feet, on log, *Clemens 40567, 40713* Penibukan, Lobang 11, above Pinokkok, elevation 5,500 feet, *Clemens 50132a;* Penibukan, elevation 6,000 feet, near Pinokkok Falls, on log, *Clemens 50131.*

MNIODENDRON ARISTINERVE Mitt.

Gurulau Kamboranga, scrub forest, elevation 7,000 to 9,000 feet, *Clemens 50787;* Gurulau Spur, elevation 8,000 feet, south side of spur, mossy elfin jungles on rock, *Clemens 51177;* head of Pinokkok River, elevation 8,000 feet, *Clemens 50871.*

BARTRAMIACEÆ

PHILONOTIS (LEIOCARPUS) IMPERFECTA sp. nov.

Dioica, laxe caespitosa, gracilis, sordide viridis. Caulis pusillus radiculosus, apice in ramulos fasciculatum divisus. Folia erecto-patentia, anguste lanceolata, breviter acuminata, carinato-concava, 0.8 mm longa, ubique serrulata; marginibus erectis vel angustissime recurvis; costa valida, percurrens, dorso fere ad basin scabra; cellulae superiores oblongae, 7 ad 8 μ latae et 10 ad 20 μ longae, apice papillosae, parietibus tenuibus, basilares subsimiles, ad 25 μ longae. Seta 16 ad 18 mm longa, tenuis; theca subglobosa, erecta, ad 1.5 mm longa; peristomium imperfectum, simplex, profunde insertum, dentes aurantiaci, papillosi, brevissimi; spori 18 ad 24 μ.

BORNEO, Mount Kinabalu, damp place, June 7, 1932, *Clemens s. n.*

This neat little plant is evidently closely allied through the rudimentary peristome to *P. tjibodensis* (Fleisch.), but appears to be perfectly distinct in the erect-spreading leaves, shorter areolation, and especially by the shorter, broader leaf points with the costa percurrent or even ending below the apex.

PHILONOTIS SECUNDA (Doz. and Molk.).

Tenompok, damp soil, elevation 5,000 feet; Penibukan, elevation 5,000 feet, on rock near Dahobang Falls, *Clemens 40290.*

New to Borneo. Distribution: Sumatra, Java, Philippines.

SPIRIDENTACEÆ

SPIRIDENS REINWARDTII Nees.

Colombon River basin, elevation 7,500 feet, north wall below falls, *Clemens 33175;* Masilan River, elevation 8,000 to 9,000 feet, forest in unexplored region, *Clemens 51665.*

ORTHOTRICHACEÆ

MACROMITRIUM PERDENSIFOLIUM Dix.

Penibukan, elevation 4,000 feet, on logs and trees near camp, *Clemens 40757, 40836.*

MACROMITRIUM (GONIOSTOMA) CLEMENSIAE sp. nov.

Robustiusculum, caespitosum, caespitibus fuscescentibus, opacis. Caulis elongatus, dense ramosus, ramis circa 2 cm longis, dense foliosis. Folia ramea sicca erecto-flexuosa, humida squarroso-recurvata, spiraliter seriata, carinato-concava, e basi ovata sensim anguste acuminata, circa 2 mm longa; marginibus erectis, apicem versus argute dentatis; costa breviter excurrente; cellulae superiores rotundatae, 8 ad 10 μ, papillosae, parietibus haud incrassatis, inferiores juxta-costales magnae, ovoidae, tuberculosae, infimae lineares, marginales anguste lineares, limbum latum 10 ad 12 seriatum formantes. Folia perichaetialia erecta, e basi lanceolata longe acuminata, ad 3.5 mm longa; seta circa 8 mm longa, rubra, ubique scabrata; theca elliptica, ore contracto, angulato; peristomium simplex, 50 ad 60 μ altum, dentibus inter se concretis, papillosis; spori variabiles ad 35 μ, papillosi.

BORNEO, Mount Kinabalu, Penibukan, elevation 4,000 feet, jungle, east ridge, on twigs of tree, *Clemens 40531* type; Penibukan, elevation 4,500 feet, jungle ridge above camp, on tree, *Clemens 50305a;* Masilan River, elevation 7,000 feet, on *Vernonia, Magnolia,* etc., *Clemens 51487b.*

If the affinities of this species are with *M. orthostichum* Nees, as seems probable, the differences are very marked; *M. Clemensiae* is a much coarser plant with finely acuminate leaves imbricated in spiral rows. The basal areolation is unique in having the coarsely tuberculate cells of the leaf base widely bordered on each side by a broad band of very narrow, incrassate smooth cells extending about one-fourth of the way up the margins.

MACROMITRIUM LONGICAULE C. M.

Pinokkok Falls, wet rocks, elevation 6,500 feet, *Clemens 50002a.*

MACROMITRIUM BLUMII Nees.

Penibukan, jungle ridge above camp, on tree trunk, elevation 4,500 feet, *Clemens 50305;* Penibukan, Pinokkok Falls, lobang, branches of tree, elevation 5,000 feet, *Clemens 40933.*

MACROMITRIUM OCHRACEUM (Doz. and Molk.) C. M.

Masilan River, elevation 5,000 feet, on tree over Lewago River, *Clemens 51484;* Masilan River, elevation 7,000 feet, on *Vernonia, Magnolia,* etc., *Clemens 51487.*

MACROMITRIUM OCHRACEOIDES Dix.

Gurulau Spur, above rise of Dahobang, on Myrtaceæ, elevation 12,500 feet, *Clemens 50998.*

SCHLOTHEIMIA WALLISI C. M.

Schlotheimia splendida Mitt.

Masilan River, elevation 7,000 feet, on *Vernonia, Magnolia,* etc., *Clemens 51487c.*

SCHLOTHEIMIA RUBIGINOSA C. H. Wright.

Gurulau Spur, above rise of Dahobang, on Myrtaceæ, elevation 12,500 feet, *Clemens 50998a.*

LEPTODONTIOPSIS ORIENTALIS Dix.

Gurulau Spur, elevation 12,000 to 13,000 feet, above Pinokkok River, granite dome, on rocks, *Clemens 51197;* Gurulau Spur, above rise of Dahobang, elevation 12,500 feet, *Clemens 50448b;* Gurulau Spur, base of Victoria Peak, elevation 12,500 feet, on granite slope.

No. *51197,* in particular, is abundant and in fine fruit. It is more robust than indicated by the description of the type collection with setæ up to 2.5 to 3 cm long, but is undoubtedly the same plant.

I willingly defer to Mr. Dixon's judgement in placing this species in *Leptodontiopsis.* It has close and natural affinities, however, with *Zygodon,* and especially with *Z. tetragonostomus* Al. Br., from which it is clearly separable by the diœcious inflorescence, more strongly toothed leaf margins, large spores up to 30 to 35 μ, and the costa papillose on the back. These distinctions are of specific importance, but their value as generic indicators remains to be established.

RHACOPILACEÆ

RHACOPILUM SPECTABILE Reinw. and Hornsch.

Penibukan, near Pinokkok Falls, on log, elevation 6,000 feet, *Clemens 50131a;* headwaters of Columbon River, on rocks, elevation 4,500 feet.

HEDWIGIACEÆ

RHACOCARPUS ALPINUS (C. H. Wright) Par.

Masilan, elevation 7,000 feet, near ford, *Clemens 51654.*

CRYPHAEACEÆ

CRYPHAEA BORNEENSIS sp. nov.

Caules secundarii elongati, flexuosi, circa 10 cm longi, irregulariter pinnati, ramis patulis, obtusis. Folia caulina sicca laxe erecta, humida erecto-patentia, 2.6 mm longa, ovata, obtusa; marginibus planis, apicem versus minute dentatis; costa valida, infra apicem soluta; cellulae superiores rotundato-hexagonae, laevissimae, 7 ad 8 μ latae, haud incrassatae, inferiores juxta-costales lineares, marginales seriebus pluribus subquadratae; folia ramea minora. Perichaetium crassum, foliis e basi late convoluta, sensim in subulam denticulatam productis; theca immersa, turgide elliptica, deoperculata circa 1 mm longa; operculum breviter conico-rostratum; calyptra ubique scabra; peristomium duplex ut videtur, exostomii dentes anguste lanceolati, papillosi, endostomium hyalinum, imperfectum, processus 0; spori minute papillosi, 25 μ.

BORNEO, Mount Tibang, elevation 1,400 m, *Mjoberg s. n.,* November, 1925.

This genus has not been recorded from Borneo, or from Malaysia, as far as I know. The long flexuose stems and foliation are suggestive of *C. dilatata* H. f. and W. from New Zealand, but the leaves are sharply toothed above and the perichætial leaves distinctly serrulate on the margins and along the edges of the rigid aristate point. The inner peristome is very rudimentary and apparently consists of an imperfect, lightly papillose, hyaline membrane about 75 μ high and more or less adherent to the teeth.

PTEROBRYACEÆ

SYMPHYSODONTELLA LAXISSIMA Bartr. and Dix. sp. nov.

Mollissima, palide viridis, nitidula. Caules ad 12 cm longi, laxissime pinnati, ramis circa 1 cm longis, complanatis, apice saepe ramuli tenuissimi microphylli emittens. Folia patentia, ad 1.5 mm longa, ecostata, ovato-lanceolata, concava, longe et tenuiter acuminata, superne minute denticulata; cellulae omnes angustissime, longae, laevissimae, sigmoideae, infimae lutescentes, alares numerosae, laxae, hyalinae sed haud vesiculosae. Caetera ignota.

BORNEO, Mount Kinabalu, Gurulau Spur, jungle spur west of camp, twining on twigs, elevation 5,000 feet, *Clemens 50558a.*

A distinct species in the lax, pinnately branched stems in contrast to the rigid, dendroid habit of most of the group. The slender, microphyllous branches occur frequently and in some of the plants are quite conspicuous.

ENDOTRICHELLA ELEGANS (Doz. and Molk.) Fleisch.

Penibukan, elevation 3,500 feet, ridge below camp, on branch, *Clemens 50053.*

METEORIACEÆ

METEORIUM MIQUELIANUM (C. M.) Fleisch.

Masilan River, elevation 7,000 feet, *Clemens 51289a, 51487a.*

No. *51487a* is a remarkably robust form with crowded, short, turgid, golden yellow branches up to 5 to 6 mm wide with leaves.

PAPILLARIA FUSCESCENS (Hook.) Jaeg.

Tenompok, on dead log, elevation 5,000 feet.

FLORIBUNDARIA FLORIBUNDA (Doz. and Molk.) Fleisch.

Masilan River, elevation 7,000 feet, *Clemens 51281, 51487c;* Penibukan, ridge, wall by side of Pinokkok Falls, elevation 6,500 feet, *Clemens 40899b.*

FLORIBUNDARIA THUIDIOIDES Fleisch.

Penibukan, near Pinokkok Falls, elevation 6,500 feet, *Clemens 40973a.*

New to Borneo. Distribution: Java, Philippines.

AEROBRYOPSIS LONGISSIMA (Doz. and Molk.) Fleisch.

Mount Kinabalu, without further data.

AEROBRYIDIUM LONGICUSPIS Broth.

Tenompok, on dead log, elevation 5,000 feet.

NECKERACEÆ

HOMALIODENDRON FLABELLATUM (Dicks.) Fleisch.

Tenompok, elevation 5,000 feet, on dead log.

PINNATELLA MUCRONATA (Lac.) Fleisch.

Jungle ridge near Dahobang River, elevation 3,500 feet, *Clemens 40594a.*

HOOKERIACEÆ

ERIOPUS REMOTIFOLIUS C. M.

Tenompok, on dead log, elevation 5,000 feet.

CALLICOSTELLA PAPILLATA (Mont.) Jaeg.

Penibukan, on old dead log, elevation 3,500 feet, *Clemens 40581a.*

CALLICOSTELLA PRABAKTIANA (C. M.) Jaeg.

Near Tuaran, elevation 500 to 700 feet, on rock in stream between paddies, *Clemens 51298.*

ACTINODONTIUM RHAPHIDOSTEGIUM (C. M.).

Dahobang River, on rocks near jungle, elevation 3,500 feet, *Clemens 40490b.*

New to Borneo. Distribution: Java, Celebes.

THUIDIACEÆ

THUIDIUM TAMARISCELLUM (C. M.).

Masilan River, near lobang, elevation 6,000 feet, *Clemens 51283.*

New to Borneo. Distribution: Northern India, Tonkin, Java, Sumatra, Philippines.

THUIDIUM GLAUCINUM (Mitt.) Mitt.

Tenompok, on dead log, elevation 5,000 feet.

THUIDIUM GLAUCINOIDES Broth.

Jungle ridge near Dahobang River, elevation 3,500 feet, *Clemens 40594b.*

THUIDIUM CYMBIFOLIUM (Doz. and Molk.).

On rock near Dahobang Falls, elevation 4,500 feet, *Clemens 40289b.*

BRACHYTHECIACEÆ

BRACHYTHECIUM PLUMOSUM (Hedw.).

Penibukan, on rock near Dahobang Falls, elevation 4,500 feet, *Clemens 40289, 40290a;* Penibukan, base of wall north of Pinokkok Falls, on rocks, elevation 7,000 feet, *Clemens 40982;* Masilan River, elevation 6,000 feet, *Clemens 51380.*

ENTODONTACEÆ

ENTODON BANDONGIAE (C. M.) Jaeg.

Damp rocks.

New to Borneo. Distribution: Java, Sumatra, Celebes, Philippines, Formosa.

SEMATOPHYLLACEÆ

TRISMEGISTIA PANDURIFORMIS (C. H. Wright) Broth.

Tenompok, damp logs, elevation 5,000 feet; head of Columbon River, mossy forest, Keebamban River, elevation 5,000 to 6,000 feet.

TRISMEGISTIA RIGIDA (Hornsch. and Reinw.) Broth.

Numerous collections at altitudes between 3,500 and 8,000 feet.

MASTOPOMA UNCINIFOLIUM (Broth.) Card.

Numerous collections from trees, logs, and stones up to 9,000 feet.

RHAPHIDOSTICHUM PILIFERUM (Broth.) Broth.

Pinokkok Falls, elevation 6,500 feet, on wet rocks, *Clemens 5002.*

New to Borneo. Distribution: Philippines.

ACROPORIUM CONVOLUTUM Fleisch.

On stones and trees, mossy jungle below Gurulau Lobang, elevation 6,000 to 8,000 feet, *Clemens 51451a.*

ACROPORIUM TURGIDUM (Doz. and Molk.) Fleisch.

Gurulau Spur, near stream, on tree trunks, *Clemens 51099.*

ACROPORIUM MONOICUM Fleisch.

Tenompok, on log, elevation 5,000 feet.

ACROPORIUM DIMINUTUM (Brid.) Fleisch.

Mount Tibang, *E. Mjoberg s. n.,* November, 1925.

TRICHOSTELEUM BOSCHII (Doz. and Molk.) Jaeg.

Penibukan, below Dahobang Falls, elevation 4,500 feet, on twig, *Clemens 40291a;* Penibukan, near Pinokkok Falls, elevation 6,000 feet, *Clemens 40973a.*

TRICHOSTELEUM LEPTOCARPON (Schwaegr.) Fleisch.

Penibukan, side ridge, jungle, elevation 4,500 feet, *Clemens 40712.*

TRICHOSTELEUM LEPTOCARPON var. ALTEPAPILLOSUM Dix.

Gurulau Spur, elevation 7,000 to 8,000 feet, *Clemens 51436;* on stones and trees, mossy jungle below Gurulau Lobang, elevation 6,000 to 8,000 feet, *Clemens 51451.*

TRICHOSTELEUM HAMATUM (Doz. and Molk.) Jaeg.

Columbon River basin, on tree, elevation 4,500 feet; Penibukan Ridge, on forest tree, elevation 4,000 feet, *Clemens 40431a.*

TAXITHELIUM LINDBERGII Ren. and Card.

Penibukan, near Pinokkok Falls, elevation 6,500 feet, *Clemens 40973.*

TAXITHELIUM MAGNUM Fleisch.

Numerous collections from Tenompok, Penibukan, and Gurulau Spur, mostly on twigs and branches of trees.

These collections vary considerably in size but differ in no way that I can see from *T. magnum* as represented in my herbarium by a specimen from Java collected and determined by Fleischer. The leaves are slenderly acuminate, sharply serrate above, the papillæ, when visible, few and inconspicuous, and the setæ often up to 2 cm or more long. The epiphytic habit on twigs and leaves seems to be constant in this series.

TAXITHELIUM SUMATRANUM (Lac.) Broth.

Penibukan Ridge, elevation 4,000 feet, damp jungle, *Clemens 40511.*

TAXITHELIUM MICRO-SIMILANS Dix.

Tenompok, damp logs, elevation 5,000 feet; Columbon River basin, on trees, elevation 4,500 feet.

HYPNACEÆ

ECTROPOTHECIUM PLICATUM Bartr. and Dix. sp. nov.

Dioicum, robustum, flavescens, parum nitidum. Caules ad 10 cm longi, radiculosi, densissime pinnati, ramis inequalibus, ad 2 cm longis, haud complanatis. Folia rigida, patentia, leniter falcata, plicata, circa 1.3 mm longa, e basi concava ovata, acuminata, apice serrata; costa bina, breviusculis, male definita; cellulae angustissime, inferiores latiores, incrassatae, valde porosae, alares paucissime, hyalinae vel nullae. Folia perichaetialia sensim longe acuminata, argute denticulata; seta 3 ad 5 cm longa; theca magna, fusca, 2 ad 2.2 mm longa, pendula, e collo distincto oblongo-elliptica; operculum conico-rostratum; calyptra ignota.

BORNEO, Mount Kinabalu, Gurulau Spur, head of Pinokkok River, elevation 8,000 feet, on twigs, *Clemens 50872.*

This species is unusually well marked by the rigid, plicate leaves, especially when dry, and the long setæ. *Ectropothecium Dixoni* Fleisch. has the leaves slightly plicate but is a much softer plant with longer leaf points and a much smaller sporophyte.

ECTROPOTHECIUM INTORQUATUM (Doz. and Molk.) Jaeg.

Tenompok, damp logs, elevation 5,000 feet.

ECTROPOTHECIUM BUITENZORGII (Bel.) Jaeg.

Gurulau Spur, elevation 4,000 feet; Tenompok trail, on stumps, etc., *Clemens 51056,* Penibukan, Lobang 11, above Pinokkok River, elevation 5,500 feet, *Clemens 50132.*

ECTROPOTHECIUM MORITZII (C. M.) Jaeg.

Tenompok, elevation 5,000 feet.

ECTROPOTHECIUM CYPEROIDES (Hook.) Jaeg.

Masilan River, elevation 6,000 feet, *Clemens 51486a;* Penibukan, jungle ridge near Dahobang River, elevation 3,500 feet, *Clemens 40594c.*

VESICULARIA RETICULATA (Doz. and Molk.) Broth.

Dahobang River, elevation 3,500 feet, on rocks near jungle, *Clemens 40490.*

New to Borneo. Distribution: India, Singapore, Java, Sumatra, Celebes, Philippines.

ISOPTERYGIUM MINUTIRAMEUM (C. M.) Jaeg.

Gurulau Spur, jungle spur, on bark of large tree near camp, elevation 5,000 feet, *Clemens 50477.*

ISOPTERYGIUM ALBESCENS (Schwaegr.) Jaeg.

Tenompok, elevation 5,000 feet, on logs.

CTENIDIADELPHUS SPINULOSUS (Broth.) Fleisch.

Tenompok, elevation 5,000 feet, on logs.

HYLOCOMIACEÆ

MACROTHAMNIUM JAVENSE Fleisch.

Penibukan, on rocks near Dahobang Falls, elevation 4,500 feet, *Clemens 40289a;* Marai Parai above Kamburanga (open places), taken from *Blechnum fluviatile* Lowe, elevation 10,000 feet, *Clemens 33122 bis.*

POLYTRICHACEÆ

RHACELOPUS PILIFER Doz. and Molk.

Penibukan, elevation 3,500 feet, on stones in stream, *Clemens 40512.*

POGONATUM WALLISI (C. M.) Jaeg.

Masilan River, elevation 6,000 feet, *Clemens 51379.*

New to Borneo. Distribution: Philippines.

POGONATUM JUNGHUHNIANUM (Doz. nad Molk.) Lac.

Tenompok, damp places, elevation 5,000 feet; jungle trail below Gurulau Kamboranga, on trees, elevation 6,000 to 8,000 feet, *Clemens 51047.*

POGONATUM MACROPHYLLOIDES Broth.

Head of Columbon River, elevation 5,000 to 7,000 feet; Gurulau Spur, elevation 7,000 to 8,500 feet, on rocks and clay soil, *Clemens 50887, 51026, 51210.*

DAWSONIA ALTISSIMA Geh.

Head of Columbon River, elevation 5,000 to 7,000 feet.

DAWSONIA BREVIFOLIA Gepp.

Gurulau Spur, elevation 7,000 to 8,000 feet, terrestrial, mossy forest, wet, *Clemens 51032;* Gurulau Spur, Gurulau Kamboranga, elevation 7,000 to 9,000 feet, *Clemens 50786;* Gurulau Spur, northwestern base of Victoria Peak, elevation 12,500 feet, shady bank, edge of rivulet, *Clemens 51407.*

ILLUSTRATION

[Drawings by the author.]

PLATE 1

FIG. 1. *Philonotis imperfecta* Bartr.; *a*, plant, × 1¼; *b* and *c*, leaves, × 20; *d*, apex of leaf, × 160; *e*, upper leaf cells and margin, × 460; *f*, part of peristome from the inside, × 160; *g*, capsule, × 14.

2. *Macromitrium Clemensiae* Bartr.; *a*, plant, × 1¼; *b* and *c*, leaves, × 20; *d*, one side of leaf base, × 160; *e*, capsule, × 20.

3. *Symphysodontella laxissima* Bartr. and Dix.; *a*, plant, × 1¼; *b* and *c*, leaves, × 20.

4. *Cryphaea borneensis* Bartr.; *a*, plant, × 1¼; *b*, stem leaf, × 20; *c*, branch leaf, × 20; *d*, upper leaf cells and margin, × 460; *e*, capsule, × 20.

5. *Ectropothecium plicatum* Bartr. and Dix.; *a*, plant, × 1¼; *b* and *c*, leaves, × 20; *d*, perichætial leaf, × 20.

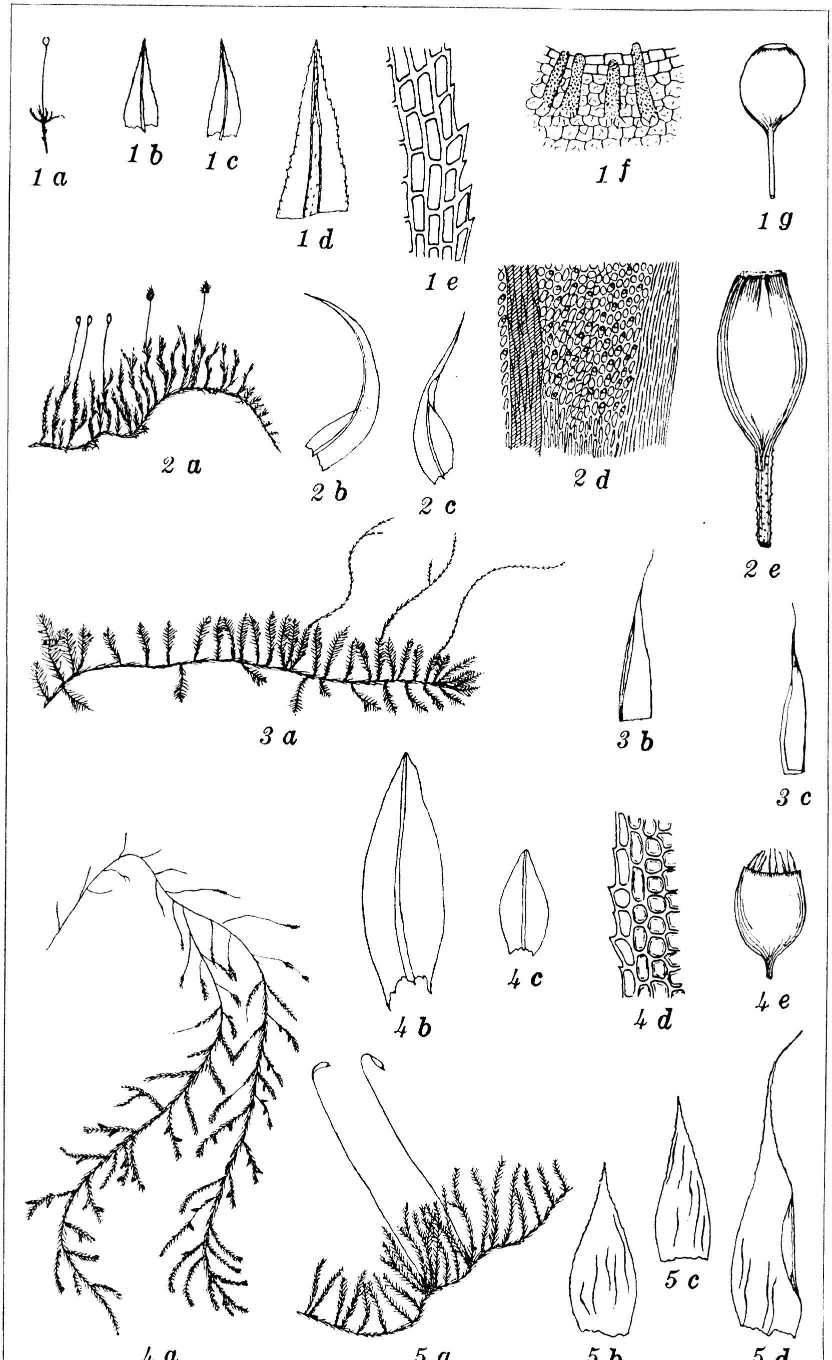


PLATE 1.

DIATOMS FROM BIWA LAKE, HONSHU ISLAND, NIPPON

By B. W. SKVORTZOW

Of Harbin, Manchoukuo

EIGHT PLATES

Several years ago Prof. Dr. Tamiji Kawamura, of Kyoto, sent me a tube of diatom clay from Biwa Lake, Nippon. Biwa Lake, one of the largest in Nippon, is north of Osaka, Honshu Island, in 35° 23′ north latitude. Its altitude is 86.3 meters, its area 644.8 square kilometers, and its maximum depth 95 meters.[1]

A careful examination of the diatom sample yielded more than two hundred forms of siliceous algæ. From systematic and geographic points of view the diatoms from Biwa Lake are of great interest. Some of these diatoms are essentially tropical, others are characteristic of alpine and Arctic regions. Among the species found in Biwa Lake, the following seem to inhabit warmer climates:

Melosira solida.	*Neidium obliquestriatum.*
Melosira americana.	*Navicula Lambda.*
Melosira undulata.	*Navicula Pusio.*
Amphipleura pellucida v. *recta.*	*Amphora delphinea* var. *minor.*
Cymbella tumidula.	*Gomphonema Berggrenii.*

The northern elements are widely represented in Biwa Lake by many large species of *Stauroneis, Navicula, Pinnularia, Gomphonema,* and *Cymbella. Didymosphenia geminata,* a common diatom in the northern part of Asia and of Europe, was also found. It was peculiar to find in Biwa Lake some species of American origin. *Melosira solida,* known from Arizona, was very abundant; *Stephanodiscus carconensis,* reported from Klamath Lake, Oregon, was represented by thousands of specimens. A distinct species, *Melosira americana,* known from tropical America, was also common in Biwa Lake. About eighty different diatoms known from Kizaki Lake were recovered in Biwa Lake. Several forms, of frequent occurrence in Kizaki Lake,

[1] Kindly reported by Dr. M. Ueno, of the Otsu Hydrobiological Station, Nippon.

were not found in the Kawamura gathering, which can scarcely be because my sample is not sufficiently large. Over seventy new species and varieties of algæ are described from Biwa Lake, and some are very distinct and peculiar.

From the ecological point of view the following diatoms from Biwa Lake are plankton species:

Melosira granulata and var.	*Attheya Zachariasi.*
Melosira solida.	*Chætoceros* sp.
Cyclotella comta and var.	*Asterionella gracillima.*
Stephanodiscus carconensis.	*Asterionella formosa.*
Coscinodiscus lacustris var.	

The other diatoms belong to a bottom formation and include large forms; such as, *Melosira undulata, Opephora Martyi, Synedra Ulna* and var., and various species of *Eunotia, Cocconeis, Achnanthes, Navicula, Pinnularia, Cymbella, Gomphonema,* and *Surirella.* The last genus was very richly represented in the lake.

All of the diatoms listed in this note are fresh-water species, and only a few forms can be referred to brackish-water species; they are *Navicula crucicula* var., *Nitzschia tryblionella, N. Lorenziana,* and *N. Clausii.* This note is illustrated with drawings by the author, and they may be useful in future investigations.

MELOSIRA VARIANS C. A. Ag.

Melosira varians C. A. Ag., FR. HUSTEDT, Bacillar. (1930) 85, fig. 41.

Frustule cylindrical, 0.08 mm broad. Rare. Reported from Aokiko and Kizaki Lakes.

MELOSIRA GRANULATA (Ehr.) Ralfs? var MUZZANENSIS (Meister) Bethge? Plate 1, fig. 20.

Melosira granulata (Ehr.) Ralfs? var. *muzzanensis* (Meister) Bethge? FR. HUSTEDT, Kryptogam. Flora 7 Band, Kieselalgen (1927) 251, fig. 105.

Frustule cylindrical, 0.01 mm broad, 0.017 mm long. Striæ punctate, 13 in 0.01 mm, forming close longitudinal rows, 15 in 0.01 mm. Not common. Known from European lakes.

MELOSIRA GRANULATA (Ehr.) Ralfs var. ANGUSTISSIMA O. Müll. Plate 1, fig. 7.

Melosira granulata (Ehr.) Ralfs var. *angustissima* O. Müll., FR. HUSTEDT, Kryptogam. Flora 7 Band, Kieselalgen (1927) 250, fig. 104*d*.

Frustule long, narrow, cylindrical, 0.027 mm long, 0.0034 broad. Puncta spiral. Uncommon in Biwa Lake. A pelagic species.

MELOSIRA SOLIDA Eulenstein. Plate 1, figs. 3 to 6, 10, 17, and 24.

Melosira solida Eulenstein, VAN HEURCK, Synopsis (1880–1881) pl. 86, figs. 36–39.

Frustule cylindrical, coarse, with thick siliceous margins. Length, 0.012 to 0.01 mm; breadth, 0.007 to 0.0085. Lateral horns massive, 0.0035 mm long. Striæ punctate, 12 in 0.01 mm, puncta 12 to 15 in 0.01 mm. Abundant in Biwa Lake. Known from Carcon, Arizona, and from Europe.

MELOSIRA SOLIDA Eulenstein var. NIPPONICA var. nov. Plate 1, figs. 1, 2, and 21.

Differs from the type in its puncta, disposed only in the middle part of the frustule. Opposite ends hyaline. Length, 0.025 mm; breadth, 0.006. Striæ 12 and puncta 12 in 0.01 mm. Common with the type species.

MELOSIRA AMERICANA Kütz. fo. NIPPONICA fo. nov. Plate 1, fig. 16.

Differs from the type in the presence of dots in the marginal sections of the frustule. Length and breadth about 0.0076 mm. The type is reported from tropical America and from Aokiko and Kizaki Lakes.

MELOSIRA UNDULATA (Ehr.) Kütz.

Melosira undulata (Ehr.) Kütz., A. SCHMIDT, Atlas Diatom. (1893) pl. 180, figs. 1–14, 16–19, 21.

Frustule cylindrical with thick margins. Length, 0.068 mm. Not common in Biwa Lake. Reported from the Tropics and as a fossil from Europe. Common in Aokiko and Kizaki Lakes.

MELOSIRA UNDULATA (Ehr.) Kütz. var NORMANNI Arnott.

Melosira undulata (Ehr.) Kütz. var. *Normanni* Arnott, VAN HEURCK, Synopsis (1880–1881) pl. 90, fig. 7.

Differs from the type in the polygonal shape of the inner part of the valve. Diameter of the frustules, 0.03 to 0.038 mm. A tropical diatom. Reported from Kizaki Lake.

CYCLOTELLA COMTA (Ehr.) Kütz.

Cyclotella comta (Ehr.) Kütz., FR. HUSTEDT, Bacillar. (1930) 103, fig. 69.

Valve circular, 0.01 to 0.015 mm in diameter. The marginal zone striated. Striæ 16 in 0.01 mm. Middle zone punctulate. Not common in Biwa Lake. Reported from Aokiko and Kizaki Lakes.

CYCLOTELLA COMTA (Ehr.) Kütz. var. OLYGACTIS (Ehr.) Grun. Plate 1, fig. 22.

Cyclotella comta (Ehr.) Kütz. var. *oligactis* (Ehr.) Grun., VAN HEURCK, Synopsis (1880–1881) pl. 93, figs. 18, 19.

Valve, 0.01 to 0.012 mm in diameter. Striæ 15 in 0.01 mm. The middle puncta coarse, arranged in radiate lines of unequal length. Rare, with the type. Known from Europe.

CYCLOTELLA GLOMERATA Bachmann fo. NIPPONICA Skvortzow. Plate 1, fig. 15.

Cyclotella glomerata Bachmann fo. *nipponica* SKVORTZOW, Diatom. Kizaki Lake (1936) pl. 1, fig. 12.

Valve very small, about 0.005 mm in diameter. Striæ fine, 18 in 0.01 mm. Common in Kizaki Lake.

STEPHANODISCUS CARCONENSIS Grun. Plate 1, figs. 19 and 23; Plate 6, fig. 2 (anomaly).

Stephanodiscus carconensis Grun., A. SCHMIDT, Atlas Diatom. (1901) pl. 228, figs. 9, 10.

Valve large, circular, with 24 to 36 radial marginal processes, 3 in 0.01 mm. Beads large, robust, radiately disposed, 15 to 18 in 0.01 mm. Diameter of the valves 0.025 to 0.045 mm. Abundant in Biwa Lake. Known from Klamath Lake, Oregon, and Shasta Country, California.

STEPHANODISCUS CARCONENSIS Grun. var. PUSILLA Grun. Plate 1, figs. 8, 9, 11 to 14, and 18.

Stephanodiscus carconensis Grun. var. *pusilla* Grun., A. SCHMIDT, Atlas Diatom. (1901) pl. 228, figs. 11, 12.

Valve minute, circular, strongly marked with coarse beads, becoming smaller only near the margin. Processes 6 to 13 radiate. Central area covered with beads. Margin distinct. Diameter of the valves 0.005 to 0.017 mm. Beads 15 in 0.01 mm. Common with the type.

STEPHANODISCUS BIWENSIS sp. nov. Plate 1, figs. 27 and 28.

Valve circular, strongly marked with coarse beads, irregularly in the center of the valve. The valve is ornamented with a corona of large spines on one-third of the valve border. Diameter of the valve 0.035 to 0.04 mm. Length of the spines 0.006 to 0.01 mm. Not common. The form most nearly resembling this species is *Stephanodiscus elegans* T. Brun, a fossil in Yedo, Nippon.

COSCINODISCUS LACUSTRIS Grun. var. NIPPONICA var. nov. Plate 1, fig. 26; Plate 6, fig. 1.

Valve circular, marked with longitudinal, radiate rows of puncta, forming in the center a hyaline space or corona of few puncta. Diameter, 0.05 to 0.06 mm. Puncta 10 in 0.01 mm. Not common in Biwa Lake. The type is known from fresh and brackish waters from large Eurasian lakes.

ATTHEYA ZACHARIASI Brun. Plate 5, fig. 15.

Attheya Zachariasi Brun, FR. HUSTEDT, Bacillar. (1930) 118, fig. 99*c*.

This species is abundant in Biwa Lake, but found only as broken valves and endocysts. Length of endocysts, 0.028 to 0.034 mm; breadth, 0.0068 to 0.0085. Reported from Aokiko Lake. A pelagic species.

CHÆTOCEROS sp.

The broken valves and filaments of this diatom were common in the Biwa sample. They were poor for identification.

TABELLARIA FENESTRATA (Lyngb.) Kütz.

Tabellaria fenestrata (Lyngb.) Kütz., FR. HUSTEDT, Bacillar. (1930) 122, fig. 99.

Valve linear, undulate in the middle part and at the ends. Length, 0.051 mm; breadth, 0.007. Common in fresh water. Uncommon in Biwa Lake. Reported from Kizaki Lake.

TABELLARIA FLOCCULOSA (Roth.) Kütz.

Tabellaria flocculosa (Roth.) Kütz., FR. HUSTEDT, Bacillar. (1930) 123, fig. 101.

Valve small, undulate. Length, 0.025 mm; breadth, 0.007. Reported from Aokiko and Kizaki Lakes.

DIATOMA HIEMALE (Lyngb.) Heiberg var. **MESODON** (Ehr.) Grun.

Diatoma hiemale (Lyngb.) Heiberg var. *mesodon* (Ehr.) Grun., FR. HUSTEDT, Bacillar. (1930) 129, fig. 116.

Valve oblong, lanceolate. Length, 0.017 mm; breadth, 0.007. Common in streams. Rare in Biwa Lake. Reported from Aokiko and Kizaki Lakes.

MERIDION CIRCULARE Agardh var. **CONSTRICTA** (Ralfs) Van Heurck.

Meridion circulare Agardh var. *constricta* (Ralfs) Van Heurck, FR. HUSTEDT, Bacillar. (1930) 131, fig. 119.

Valve clavate and capitate. Length, 0.039 mm; breadth, 0.005. Rare. Reported from Kizaki Lake.

OPEPHORA MARTYI Herib.

Opephora Martyi Herib., FR. HUSTEDT, Bacillar. (1930) 132, fig. 120.

Valve ovate, attenuate towards both ends. Length, 0.019 mm; breadth, 0.005. Striæ robust, 7 to 8 in 0.01 mm. Common. Known from the bottoms of large lakes. Reported from Aokiko and Kizaki Lakes.

FRAGILARIA CAPUCINA Desm.

Fragilaria capucina Desm., FR. HUSTEDT, Bacillar. (1930) 138, fig. 126.

Valve linear, almost parallel, with slightly attenuated and rounded ends. Length, 0.022 mm; breadth, 0.002. Striæ 18 in 0.01 mm. Common in fresh water. Known from Aokiko and Kizaki Lakes.

CERATONEIS ARCUS Kütz. var. HATTORIANA Meister.

Ceratoneis arcus Kütz. var. *Hattoriana* MEISTER, Beiträge zur Bacillariaceenflora Japans. 2 (1914) 226–227, pl. 8, figs. 1–3.

Valve linear-lanceolate, attenuate at the ends. Length, 0.034 mm; breadth, 0.005. Striæ 15 in 0.01 mm. Reported from Tokyo and Kizaki Lakes. Not common in Biwa Lake.

ASTERIONELLA GRACILLIMA (Hantzsch) Heiberg.

Asterionella gracillima (Hantzsch) Heiberg, FR. HUSTEDT, Bacillar. (1930) 147–148, fig. 157.

Valve linear with equally undulate ends. Length, 0.08 to 0.09 mm; breadth, 0.0017. Known from Kizaki Lake. A pelagic species.

ASTERIONELLA FORMOSA Hassall.

Asterionella formosa Hassall, FR. HUSTEDT, Bacillar. (1930) 147, fig. 156.

Valve linear, ends unequally undulate. Length, 0.075 mm; breadth, 0.0017. Known from Aokiko Lake. Not abundant in Biwa Lake.

SYNEDRA ULNA (Nitzsch) Ehr.

Synedra Ulna (Nitzsch) Ehr., FR. HUSTEDT, Bacillar. (1930) 151, figs. 158–159.

Valve linear, parallel, with attenuate ends. Length, 0.16 to 0.2 mm; breadth, 0.005 to 0.006. Striæ 9 in 0.01 mm. Not common. Reported from Aokiko and Kizaki Lakes.

SYNEDRA ULNA (Nitzsch) Ehr. var. RAMESI (Herib. and Peragallo) Hust. Plate 6, fig. 14.

Synedra Ulna (Nitzsch) Ehr. var. *Ramesi* (Herib. and Peragallo) Hust., HUSTEDT, Bacillar. (1930) 152, fig. 163.

Valves broad, short with abruptly acuminate ends. Length, 0.039 to 0.042 mm; breadth, 0.007 to 0.0085. Striæ 9 to 10 in 0.01 mm. Reported from Kizaki Lake.

SYNEDRA ULNA (Nitzsch) Ehr. var. DANICA (Kütz.) Grun.

Synedra Ulna (Nitzsch) Ehr. var. *danica* (Kütz.) Grun., FR. HUSTEDT, Bacillar. (1930) 154, fig. 168.

Valve very long and narrow, regularly attenuate towards the ends. Ends capitate. Length, 0.217 mm; breadth, 0.0048 to 0.005. Striæ 9 in 0.01 mm. Reported from Kizaki Lake.

SYNEDRA ULNA (Nitzsch) Ehr. var. OXYRHYNCHUS (Kütz.) Van Heurck fo. CONSTRICTA Hustedt. Plate 2, fig. 16.

Synedra Ulna (Nitzsch) Ehr. var. *oxyrhynchus* (Kütz.) Van Heurck fo. *constricta* HUSTEDT, Bacillar. (1930) 152, fig. 161.

Valve linear, abruptly constricted in the middle. Ends acuminate. Length, 0.078 mm; breadth, 0.006. Striæ 9 in 0.01 mm. Not common.

SYNEDRA ULNA (Nitzsch) Ehr. var. AMPHIRHYNCHUS (Ehr.) Grun.

Synedra Ulna (Nitzsch) Ehr. var. *amphirhynchus* (Ehr.) Grun., FR. HUSTEDT, Bacillar. (1930) 154, fig. 167.

Valve linear, attenuate and capitate. Length, 0.12 mm; breadth, 0.0068. Striæ 7 in 0.01 mm. Common in Biwa Lake.

SYNEDRA NANA Meister.

Synedra nana Meister, FR. HUSTEDT, Bacillar. (1930) 158, fig. 183.

Valve very narrow-linear, gradually attenuate to the ends. Length, 0.044 mm; breadth, 0.002. Striæ fine, 24 in 0.01 mm. Reported from alpine lakes, Lago di Crocetto, Bernina, Davoser Lake, Europe.

SYNEDRA NANA Meister var. NIPPONICA Skvortzow. Plate 5, fig. 21.

Synedra nana Meister var. *nipponica* SKVORTZOW, Diatom. Kizaki Lake (1936) pl. 10, fig. 29.

Smaller than the type. Ends capitate. Length, 0.027 mm; breadth, 0.0012. Striæ 25 in 0.01 mm. Differs from the specimens from Kizaki Lake in the narrower valves and the number of striæ. Not common.

SYNEDRA RUMPENS Kütz. var. MENEGHINIANA Grun.

Synedra rumpens Kütz. var. *Meneghiniana* Grun., FR. HUSTEDT, Bacillar. (1930) 156, fig. 178.

Valve linear-lanceolate with slightly capitate ends. Length, 0.027 mm; breadth, 0.0034. Striæ 12 in 0.01 mm. Reported from Kizaki Lake.

SYNEDRA RUMPENS Kütz. var. **FRAGILARIOIDES** Grun. fo. **NIPPONICA** fo. nov. Plate 3, fig. 7.

Differs from the type in its finer striæ. In the middle part the valve is undulate. Length, 0.018 mm; breadth, 0.0034. Striæ 15 in 0.01 mm, not punctate. Uncommon in Biwa Lake.

SYNEDRA VAUCHERIÆ Kütz. var. **CAPITELLATA** Grun.

Synedra Vaucheriæ Kütz. var. *capitellata* Grun., FR. HUSTEDT, Bacillar. (1930) 161, fig. 194.

Valve linear-lanceolate with attenuate and capitate ends. Length, 0.015 mm; breadth, 0.0032. Striæ 18 in 0.01 mm. Reported from Kizaki Lake.

SYNEDRA MINUSCULA Grun. var. **CAPITATA** var. nov. Plate 1, fig. 25.

Differs from the type in its short capitate ends. Length, 0.02 mm; breadth, 0.003. Striæ 15 in 0.01 mm. Uncommon in Biwa Lake.

SYNEDRA PARASITICA W. Sm. Plate 2, fig. 21.

Fragilaria parasitica W. Sm., A. SCHMIDT, Atlas Diatom. (1913) pl. 296, figs. 79–80.

A distinct species with lanceolate valve, enlarged in the middle and attenuate towards the ends. Length, 0.024 mm; breadth, 0.0034. Striæ 18 in 0.01 mm. Common in Biwa Lake. Reported from Kizaki Lake.

SYNEDRA ACUS Kütz. Plate 2, fig. 4.

Synedra acus Kütz., A. SCHMIDT, Atlas Diatom. (1914) pl. 303, fig. 7.

Valve linear-lanceolate. Length, 0.09 mm; breadth, 0.005. Striæ 12 in 0.01 mm. Common in fresh water.

SYNEDRA NIPPONICA Skvortzow. Plate 4, fig. 13.

Synedra nipponica SKVORTZOW, Diatoms Kizaki Lake (1936) pl. 1, fig. 43.

Valve small, lanceolate, enlarged in the middle, gradually attenuate towards the ends. Length, 0.0085 mm; breadth, 0.0019. Striæ 24 in 0.01 mm. Differs from the Kizaki specimen in its coarser striæ.

EUNOTIA GRACILIS (Ehr.) Rabh. Plate 8, fig. 12.

Eunotia gracilis (Ehr.) Rabh., FR. HUSTEDT, Bacillar. (1930) 185, fig. 253.

Valve linear, slightly curved, with parallel margins. Ends capitate. Length, 0.05 to 0.093 mm; breadth, 0.004 to 0.005. Striæ 10 in 0.01 mm. Reported from Kizaki Lake.

EUNOTIA PRÆRUPTA Ehr. var. BIDENS Grun. Plate 8, fig. 13.

Eunotia prærupta Ehr. var. *bidens* Grun., FR. HUSTEDT, Bacillar. (1930) 174, fig. 213.

Valve robust, genuflexed, biundulate with rostrate and truncate ends. Length, 0.083 mm; breadth, 0.013. Striæ 8 in 0.01 mm. Not common.

EUNOTIA PECTINALIS (Kütz.) Rabh. var. MINOR (Kütz.) Rabh.

Eunotia pectinalis (Kütz.) Rabh. var. *minor* (Kütz.) Rabh., FR. HUSTEDT, Bacillar. (1930) 182, fig. 238.

Valve linear, genuflexed, slightly gibbous in the middle, with short attenuate ends. Length, 0.034 mm; breadth, 0.0042. Striæ 14 in 0.01 mm. Reported from Kizaki Lake.

EUNOTIA PECTINALIS (Kütz.) Rabh. var. MINOR (Kütz.) Rabh. fo. IMPRESSA (Ehr.).

Eunotia pectinalis (Kütz.) Rabh. var. *minor* (Kütz.) Rabh. fo. *impressa* (Hustedt), Bacillar. (1930) 182, fig. 239.

Valve reflexed. Length, 0.027 mm; breadth, 0.0065. Striæ 15 in 0.01 mm. Known from Aokiko Lake.

EUNOTIA SUDETICA (O. Müll.) Hust. var. NIPPONICA var. nov. Plate 2, fig. 15.

Valve genuflexed, gradually attenuate towards the ends. Ends slightly capitate, broad, rounded. Length, 0.037 mm; breadth, 0.005. Striæ 6 in 0.01 mm. Differs from the type in its more elongate valves and wider striæ. Uncommon.

EUNOTIA VENERIS (Kütz.) O. Müll.

Eunotia veneris (Kütz.) O. Müll., FR. HUSTEDT, Bacillar. (1930) 182–183, fig. 245.

Valve linear, straight on the ventral side, reflexed at the dorsal side. Ends acute. Length, 0.0187 mm; breadth, 0.004. Striæ 15 in 0.01 mm. Uncommon.

EUNOTIA LUNARIS (Ehr.) Grun.

Eunotia lunaris (Ehr.) Grun., FR. HUSTEDT, Bacillar. (1930) 183–184, fig. 249.

Valve linear, lunate with parallel margins and rounded ends. Length, 0.052 mm; breadth, 0.004. Striæ 15 in 0.01 mm. Reported from Kizaki Lake.

ACTINELLA BRASILIENSIS Grun.

Actinella brasiliensis Grun., SKVORTZOW, Diatoms Kizaki Lake (1936) pl. 8, fig. 11.

Valve linear, clavate, broad-capitate and apiculate at the apex, regularly attenuate towards the end. Length, 0.08 to 0.09 mm.

Not common. Reported from Kizaki Lake, Chosen, and Hanka Lake.

COCCONEIS PLACENTULA (Ehr.).

Cocconeis placentula (Ehr.) FR. HUSTEDT, Bacillar. (1930) 189, fig. 260.

Valve elliptical. Length, 0.04 mm; breadth, 0.025. Uncommon. Reported from Aokiko Lake.

COCCONEIS PLACENTULA (Ehr.) var. EUGLYPTA (Ehr.) Cleve.

Cocconeis placentula (Ehr.) var. *euglypta* (Ehr.) Cleve, FR. HUSTEDT, Bacillar. (1930) 190, fig. 261.

Differs from the type in its fine, longitudinal, undulating, blank bands. Length, 0.0085 mm; breadth, 0.0068. Uncommon in Biwa Lake. A fresh-water diatom.

COCCONEIS PLACENTULA (Ehr.) var. LINEATA (Ehr.) Cleve.

Cocconeis placentula (Ehr.) var. *lineata* (Ehr.) Cleve, FR. HUSTEDT, Bacillar. (1930) 190, fig. 262.

Valve elliptical, crossed by fine, longitudinal, undulating, blank bands. Length, 0.024 mm; breadth, 0.014. Reported from Kizaki Lake.

COCCONEIS DISCULUS Schum. var. NIPPONICA var. nov. Plate 4, fig. 16.

Broader and smaller than the type form. Length, 0.014 mm; breadth, 0.01. Striæ 10 in 0.01 mm. *Cocconeis disculus* is known from bottoms of European lakes.

COCCONIES DIMINUTA Pant.

Cocconeis diminuta Pant., FR. HUSTEDT, Bacillar. (1930) 191–192, fig. 265.

Valve elliptical. Length, 0.01 mm; breadth, 0.0085. Lower valve with very fine striæ, upper valve with more-robust striation. Striæ 18 in 0.01 mm. Reported from Aokiko and Kizaki Lakes. Known from European lakes.

EUCOCCONEIS ONEGENSIS Wisl. and Kolbe. Plate 6, figs. 4 and 5.

Eucocconeis onegensis WISLOUCH and KOLBE, New diatoms from Russia (1916) Journ. Microbiol. 3: 169–271, pl. 3, figs. 5, 6; Beiträge zur Diatomeenflora des Onego-Sees (1927) 33, 72, pl. figs. 2, 3.

Valve robust, lanceolate, broad-undulate at the middle, gradually attenuate towards the ends. Length, 0.03 mm; breadth, 0.015. Upper valve with radiate striæ. Central area oblique, rectangular from one side, dilated on the other side. Axial area narrow, filiform. Lower valve rectangular, with a broad stauros, widened and truncate outwards. Striæ punctate, 18 in

0.01 mm. Uncommon. Known from Onega Lake, northern Europe, Russia.

ACHNANTHES MINUTISSIMA Kütz.

Achnanthes minutissima Kütz., FR. HUSTEDT, Bacillar. (1930) 198, fig. 274.

Valve linear-elliptical, attenuate towards the ends. Length, 0.013 mm; breadth, 0.002. Striæ 30 in 0.01 mm. Reported from Kizaki Lake. Common in Biwa Lake.

ACHNANTHES HAUCKIANA Grun. var. NIPPONICA var. nov. Plate 6, fig. 12.

Differs from the type in its rounded ends and slightly undulated middle part. Length, 0.011 mm; breadth, 0.003. Striæ 12 in 0.01 mm, more distinct in the middle part of the valve. Uncommon.

ACHNANTHES CLEVEI Grun. Plate 2, fig. 3.

Achnanthes Clevei Grun., FR. HUSTEDT, Bacillar. (1930) 203, fig. 294.

Valve elliptical-lanceolate with attenuate ends. Length, 0.012 mm; breadth, 0.0058. Upper valve with a narrow, linear, axial area, with robust striæ, 12 in 0.01 mm. Lower valve with outward-dilated central area. Striæ radiate, punctate, 24 in 0.01 mm, in the middle of unequal length. Common. Reported from Aokiko Lake.

ACHNANTHES CLEVEI Grun. var. NIPPONICA Skvortzow. Plate 5, fig. 5.

Achnanthes Clevei Grun. var. *nipponica* SKVORTZOW, Diatoms Kizaki Lake (1936) pl. 2, fig. 24.

Valve long-elliptical with attenuate ends. Length, 0.027 mm; breadth, 0.0068. Striæ of the upper valve 9, of the lower valve 21, in 0.027 mm. Known from Kizaki Lake.

ACHNANTHES PINNATA Hust. var. JAPONICA Hustedt.

Achnanthes pinnata Hust. var. *japonica* HUSTEDT, Bacillar. aus dem Aokikosee in Japan 161, pl. 5, figs. 12, 13.

Valve minute, ovate with rounded ends. Length, 0.005 mm; breadth, 0.0027. Striæ 22 in 0.01 mm. Reported from Aokiko and Kizaki Lakes. The type is known from central Asia.

ACHNANTHES PERAGALLII Brun and Heribaud.

Achnanthes Peragallii Brun and Heribaud, FR. HUSTEDT, Bacillar. (1930) 207, fig. 300.

Valve lanceolate with abruptly attenuate and capitate ends. Length, 0.01 mm; breadth, 0.006. Reported from Aokiko and Kizaki Lakes.

ACHNANTHES LINEARIS W. Smith fo. MINUTA fo. nov.

Differs from the type in its smaller size. Valve linear-elliptical, slightly siliceous. Length, 0.0068 mm; breadth, 0.002. The type was reported from Aokiko and Kizaki Lakes.

ACHNANTHES AFFINIS Grun. Plate 5, fig. 18.

Achnanthes affinis Grun., FR. HUSTEDT, Bacillar. (1930) 199, fig. 282.

Valve linear-lanceolate, enlarged in the middle part, attenuate and capitate. Length, 0.012 mm; breadth, 0.0025. Striæ very fine, 30 in 0.01 mm. Uncommon.

ACHNANTHES BIASOLETTIANA Kütz. Plate 5, fig. 14.

Achnanthes Biasolettiana Kütz., FR. HUSTEDT, Bacillar. (1930) 199, fig. 289.

Valve broad linear-elliptical, undulate in the middle, broadly rounded at the ends. Length, 0.012 mm; breadth, 0.0053. Striæ very fine, 30 in 0.01 mm. Uncommon.

ACHNANTHES LANCEOLATA Breb.

Achnanthes lanceolata Breb., FR. HUSTEDT, Bacillar. (1930) 207, fig. 306*a*.

Valve lanceolate-elliptical with broad ends. Length, 0.012 mm; breadth, 0.005. Striæ 15 in 0.01 mm. Reported from Aokiko and Kizaki Lakes. Common in Biwa Lake.

ACHNANTHES LANCEOLATA Breb. var. ROSTRATA Hust.

Achnanthes lanceolata Breb. var. *rostrata* HUSTEDT, Bacillar. (1930) 208, fig. 306*b*.

Valve with rostrate ends. Length, 0.009 mm; breadth, 0.005. Striæ 12 in 0.01 mm. Reported from Kizaki Lake.

ACHANANTHES LANCEOLATA Breb. var. ELLIPTICA Cleve.

Achnanthes lanceolata Breb. var. *elliptica* Cleve, FR. HUSTEDT, Bacillar. (1930) 208, fig. 306*c*.

Valve broad-elliptical. Length, 0.015 mm; breadth, 0.0068. Known from Kizaki Lake.

ACHNANTHES LANCEOLATA Breb. var. NIPPONICA Skvortzow.

Achnanthes lanceolata Breb. var. *nipponica* SKVORTZOW, Diatoms Kizaki Lake (1936) pl. 12, fig. 13.

Valve broad-lanceolate, slightly gibbous in the middle, obtuse. Length, 0.015 mm; breadth, 0.065. Striæ 12 in 0.01 mm. Differs from the type in its short valves. Common in Biwa Lake. Reported from Kizaki Lake.

ACHNANTHES EXIGUA Grun. var. INDICA Skvortzow.

Achnanthes exigua Grun. var. *indica* SKVORTZOW, Diatoms from Calcutta (1935) pl. 1, fig. 3.

Valve slightly siliceous, short. Length, 0.0076 mm; breadth, 0.0042. Reported from Calcutta and Kizaki Lake.

RHOICOSPHENIA CURVATA (Kütz.) Grun. Plate 2, fig. 14.

Rhoicosphenia curvata (Kütz.) Grun., FR. HUSTEDT, Bacillar. (1930) 211, fig. 311.

Valve linear, clavate, attenuate towards the ends. Length, 0.042 mm; breadth, 0.0068. Striæ 12 in 0.01 mm. Known from Aokiko and Kizaki Lakes.

RHOICOSPHENIA CURVATA (Kütz.) Grun. var. MAJOR Cleve. Plate 7, fig. 2.

Rhoicosphenia curvata (Kütz.) Grun. var. *major* CLEVE, Synopsis Navicul. Diatoms 2 (1895) 165.

Larger than the type. Length, 0.078 mm; breadth, 0.0085. Striæ 11 in 0.01 mm. Known from Pitt River, Oregon, North America. Not common in Biwa Lake.

AMPHIPLEURA PELLUCIDA Kütz. var. RECTA Kitton.

Amphipleura pellucida Kütz. var. *recta* Kitton, P. CLEVE, Synopsis Navicul. Diatoms (1894) 1, 127; SKVORTZOW, Diatoms Kizaki Lake (1936) pl. 3, fig. 6.

Valve linear with gently cuneate ends. Length, 0.25 mm; breadth, 0.017. Known from Kizaki Lake, Nippon, and from southern China. Found by Kitton in stomachs of Nipponese oysters. A fresh-water species.

FRUSTULIA RHOMBOIDES (Ehr.) de Toni var. SAXONICA (Rabh.) de Toni fo. NIPPONICA fo. nov. Plate 4, fig. 14.

Valve elliptical, attenuate. Length, 0.034 mm; breadth, 0.011. Differs from the type in its broader valves. Not common.

FRUSTULIA RHOMBOIDES (Ehr.) de Toni var. AMPHIPLEUROIDES Grun.

Frustulia rhomboides (Ehr.) de Toni var. *amphipleuroides* Grun., FR. HUSTEDT, Bacillar. (1930) 221, fig. 326.

Valve lanceolate, narrow. Length, 0.105 mm; breadth, 0.019. Reported from Aokiko and Kizaki Lakes.

FRUSTULIA VULGARIS Thwait. var. ASIATICA Skvortzow. Plate 6, fig. 6.

Frustulia vulgaris Thwait. var. *asiatica* SKVORTZOW, Diatoms from N. Manchuria (1928) 42, pl. 2, fig. 12.

Valve linear-lanceolate with obtuse, truncate, and broad ends. Length, 0.044 mm; breadth, 0.008. Reported from Manchuria and Ceylon.

GYROSIGMA KUTZINGII (Grun.) Cleve.

Gyrosigma Kutzingii (Grun.) Cleve, FR. HUSTEDT, Bacillar. (1930) 224, fig. 333.

Valve sigmoid, gradually attenuate towards the ends. Length, 0.105 mm; breadth, 0.0013. Longitudinal striæ 21, transverse striæ 26, in 0.01 mm. Reported from Aokiko and Kizaki Lakes.

GYROSIGMA ACUMINATUM (Kütz.) Rabh.

Gyrosigma acuminatum (Kütz.) Rabh., FR. HUSTEDT, Bacillar. (1930) 222, fig. 329.

Valve large and robust. Length, 0.184 mm; breadth, 0.02. Longitudinal and transverse striæ 18 in 0.01 mm. Known from Kizaki Lake.

GYROSIGMA SPENCERII (W. Smith) Cleve var. NODIFERA Grun. Plate 3, fig. 4.

Gyrosigma Spencerii (W. Smith) Cleve var. *nodifera* Grun., FR. HUSTEDT, Bacillar. (1930) 226, fig. 337.

Valve robust, broad, with rounded, oblique ends. Length, 0.122 mm; breadth, 0.017. Longitudinal striæ 24, transverse 22 to 24, in 0.01 mm. The transverse striæ in the middle part of the valve radiate. Not common. Known from fresh waters.

GYROSIGMA ATTENUATUM (Kütz.) Rabh. var. NIPPONICA var. nov. Plate 7, fig. 1.

Valve broad-linear, slightly sigmoid with attenuate ends. Length, 0.158 to 0.16 mm; breadth, 0.0187 to 0.0192. Longitudinal striæ narrow, 21 to 24 in 0.01 mm, in the middle part radiate. Central area oblique, terminal area distinct, obliquely enlarged. Seems to be a distinct species. Not common. Differs from the type in having coarser transverse striæ.

CALONEIS BACILLUM (Grun.) Meresch.

Caloneis bacillum (Grun.) Meresch., FR. HUSTEDT, Bacillar. (1930) 236, fig. 360*a*.

Valve linear or linear-lanceolate with parallel margins and rounded ends. Length, 0.037 mm; breadth, 0.007. Striæ 18 in 0.01 mm. Uncommon.

CALONEIS BACILLUM (Grun.) Meresch. var. LANCETTULA (Schulz.) Hustedt. Plate 2, fig. 9.

Caloneis bacillum (Grun.) Meresch. var. *lancettula* (Schulz.) HUSTEDT, Bacillar. (1930) 236, fig. 361.

Valve lanceolate. Length, 0.018 to 0.034 mm; breadth, 0.004 to 0.0085. Striæ 24 to 26 in 0.01 mm. Reported from Aokiko Lake.

CALONEIS BACILLUM (Grun.) Meresch. var. LANCETTULA (Schulz.) Hust. fo. DENSISTRIATA fo. nov. Plate 7, fig. 11.

Valve lanceolate with attenuate ends. Length, 0.034 mm; breadth, 0.0085. Striæ very fine, about 35 to 40 in 0.01 mm. Differs from variety *lancettula* in its fine striæ. Not common.

CALONEIS SILICULA (Ehr.) Cleve var. TUMIDA Hust.

Caloneis silicula (Ehr.) Cleve var. *tumida* HUSTEDT, Bacillar. (1930) 218, fig. 367.

Valve robust, undulate with attenuate ends. Length, 0.072 to 0.09 mm; breadth, 0.013 to 0.015. Reported from Kizaki Lake.

CALONEIS SILICULA Ehr. var. BAICALENSIS Skv. and Mayer. Plate 6, fig. 9.

Caloneis silicula Ehr. var. *baicalensis* SKVORTZOW and MAYER, Contribut. Diatom. of Baikal Lake (1928) 12, pl. 1, fig. 44.

Valve linear-triundulate. Length, 0.04 to 0.052 mm; breadth, 0.0068 to 0.0076. Striæ 20 to 24 in 0.01 mm. Differs from variety *Kjellmaniana* Grun. in its coarser striæ. Reported from Kizaki Lake.

CALONEIS SILICULA (Ehr.) Cleve var. TRUNCATULA Grun.

Caloneis silicula (Ehr.) Cleve var. *truncatula* Grun., FR. HUSTEDT, Bacillar. (1930) 238, fig. 364*b*.

Valve linear, slightly attenuate with broad rounded ends. Length, 0.045 mm; breadth, 0.01. Reported from Kizaki Lake.

CALONEIS PUNCTATA sp. nov. Plate 3, fig. 18.

Valve broad, linear-elliptical with broad ends and enlarged middle part. Length, 0.018 mm; breadth, 0.006. Striæ punctate, almost parallel, 15 in 0.01 mm. Puncta about 25 to 30 in 0.01 mm. Axial and central areas very narrow. Median line straight. Uncommon. A form akin to *Caloneis Zachariasi* Reichelt.

CALONEIS NIPPONICA sp. nov. Plate 2, fig. 7; Plate 3, fig. 9; Plate 4, fig. 15.

Valve linear-biundulate with broadly truncate and rounded ends. Length, 0.042 to 0.06 mm; breadth, 0.007 to 0.01. Central area a broad stauros. Striæ radiate, 17 to 18 in 0.01 mm. Median line straight, axial area linear and slightly enlarged. This new species is akin to *Caloneis columbiensis* Cleve, found in Columbia River, Oregon, and to the marine diatom *C. clavigera* Cleve. Common in Biwa Lake.

NEIDIUM DUBIUM (Ehr.) Cleve fo. CONSTRICTA Hustedt. Plate 3, fig. 15.

Neidium dubium (Ehr.) Cleve fo. *constricta* HUSTEDT, Bacillar. (1930) 246, fig. 384*b*.

Valve linear, minute. Length, 0.037 mm; breadth, 0.01. Striæ very fine, 24 to 28 in 0.01 mm. Common.

NEIDIUM HITCHCOCKII Ehr.

Neidium Hitchcockii Ehr., A. SCHMIDT, Atlas Diatom. (1877) pl. 49, figs. 35, 36.

Valve triundulate. Length, 0.051 mm; breadth, 0.013. Common. Reported from Aokiko and Kizaki Lakes.

NEIDIUM IRIDIS (Ehr.) Cleve.

Neidium iridis (Ehr.) Cleve, FR. HUSTEDT, Bacillar. (1930) 245, fig. 379.

Valve linear-lanceolate, attenuate towards the ends. Length, 0.049 to 0.01 mm; breadth, 0.018 to 0.025. Striæ 15 to 20 in 0.01 mm. Uncommon in Biwa Lake. Known from Aokiko Lake.

NEIDIUM OBLIQUESTRIATUM A. S. Plate 2, fig. 12.

Neidium obliquestriatum A. Smith, A. SCHMIDT, Atlas Diatom. (1877) pl. 49, figs. 41, 42.

Valve triundulate with truncate ends. Length, 0.068 to 0.0153 mm; breadth, 0.012 to 0.025. Striæ oblique, 18 to 24 in 0.01 mm. Median line straight, axial area linear. Uncommon in Biwa Lake. Reported from Demerara River, Brazil, and from Aokiko Lake, Nippon.

NEIDIUM OBLIQUESTRIATUM A. S. var. NIPPONICA Skvortzow.

Neidium obliquestriatum A. S. var. *nipponica* SKVORTZOW, Diatoms Kizaki Lake (1936) pl. 4, fig. 22.

Valve lanceolate with attenuate ends. Length, 0.068 mm; breadth, 0.017. Striæ oblique, 21 in 0.01 mm. Common. Reported from Kizaki Lake.

NEIDIUM OBLIQUESTRIATUM A. S. var. ELONGATA var. nov. Plate 8, fig. 1.

Valve linear-lanceolate or linear-elliptical, gradually attenuate to the ends. Length, 0.085 mm; breadth, 0.015. Striæ oblique, 21 to 24 in 0.01 mm. Central area broad, oblique. Differs from the type in its elongate, not triundulate, valves. Common.

DIPLONEIS OVALIS (Hilse) Cleve.

Diploneis ovalis (Hilse) Cleve, FR. HUSTEDT, Bacillar. (1930) 249, fig. 390.

Valve broad-elliptical with rounded ends. Length, 0.042 mm; breadth, 0.023. Central area broad. Striæ radiate, 10 in 0.01

mm. Puncta 12 in 0.01 mm. Not common. Reported from Aokiko and Kizaki Lakes.

DIPLONEIS OVALIS (Hilse) Cleve var. OBLONGELLA (Naegeli) Cleve. Plate 5, fig. 19.

Diploneis ovalis (Hilse) Cleve var. *oblongella* (Naegeli) Cleve, FR. HUSTEDT, Bacillar. (1930) 249, fig. 391.

Valve linear with rounded ends. Length, 0.046 to 0.091 mm; breadth, 0.017 to 0.027. Striæ radiate, 8 to 9 in 0.01 mm. Puncta 15 in 0.01 mm. Reported from Aokiko and Kizaki Lakes. Common in Biwa Lake.

DIPLONEIS OVALIS (Hilse) Cleve var. OBLONGELLA (Naegeli) Cleve fo. NIPPONICA fo. nov. Plate 2, fig. 23.

Valve small, elliptical. Length, 0.02 mm; breadth, 0.0085. Striæ 8 in 0.01 mm. Puncta very fine. Differs from the type in its short valve. Not common.

DIPLONEIS OVALIS (Hilse) Cleve var. BIPUNCTATA var. nov. Plate 3, fig. 1.

Valve broad-elliptical, undulate, attenuate towards the ends. Length, 0.03 mm; breadth, 0.02. Striæ bipunctate, 8 to 9 in 0.01 mm. Differs from the type in its bipunctate striæ. Common. Reported by F. Hustedt from Aokiko Lake and related to *Diploneis ovalis*.

DIPLONEIS OVALIS (Hilse) Cleve var. NIPPONICA var. nov. Plate 4, fig. 11.

Valve elliptical with attenuate ends. Length, 0.076 mm; breadth, 0.028. Striæ 8 in 0.01 mm. Puncta 15 in 0.01 mm. Differs from variety *oblongella* in its elliptical valve. Uncommon.

DIPLONEIS SMITHII (Breb.) Cleve var. NIPPONICA Skvortzow.

Diploneis Smithii (Breb.) Cleve var. *nipponica* SKVORTZOW, Diatoms Kizaki Lake (1936) pl. 2, figs. 1, 9.

Valve elliptical. Length, 0.06 to 0.085 mm; breadth, 0.03 to 0.04. Differs from the type in its more elongate and attenuate ends. Known from Kizaki Lake.

DIPLONEIS MARGINESTRIATA Hustedt var. NIPPONICA var. nov. Plate 4, fig. 3.

Valve linear-elliptical with broad, rounded ends. Length, 0.039 mm; breadth, 0.0136. Striæ 17 in 0.01 mm. Central area rectangular. Differs from the type in its striæ, from axial area to the margin, being without interruption. The type species is reported from Aokiko Lake.

DIPLONEIS PUELLA (Schum.) Cleve.

Diploneis puella (Schum.) Cleve, FR. HUSTEDT, Bacillar. (1930) 250, fig. 394.

Valve elliptical, small, with broad ends. Length, 0.02 mm; breadth, 0.01. Striæ radiate, 10 in 0.01 mm. Common. Reported from Kizaki Lake.

STAURONEIS ANCEPS Ehr. var. SIBIRICA Grun.

Stauroneis anceps Ehr. var. *sibirica* Grun., CLEVE and GRUNOW, Arctische Diatomeen (1880) pl. 3, fig. 65.

Valve linear-lanceolate with gradually attenuated ends. Length, 0.051 mm; breadth, 0.013. Central area a broad stauros widened and truncate outwards. Rare.

STAURONEIS ANCEPS Ehr. var. HYALINA Brun and Peragallo.

Stauroneis anceps Ehr. var. *hyalina* Brun and Peragallo, FR. HUSTEDT, *Bacillar.* (1930) 256, fig. 408.

Valve lanceolate with long-acuminate ends. Length, 0.054 mm; breadth, 0.01. Striæ very fine, about 30 in 0.01 mm. Uncommon.

STAURONEIS PHŒNICENTERON Ehr.

Stauroneis phœnicenteron Ehr., FR. HUSTEDT, Bacillar. (1930) 255, fig. 404.

Valve lanceolate with obtuse ends. Length, 0.095 mm; breadth, 0.017. Striæ radiate, 18 in 0.01 mm. Common. Reported from Aokiko and Kizaki Lakes.

STAURONEIS SMITHII Grun. var. RHOMBICA Meister. Plate 5, fig. 7.

Stauroneis Smithii Grun. var. *rhombica* MEISTER, Beiträge zur Bacillar. Japans. (1930) 228, pl. 8, fig. 5.

Valve rhombic-lanceolate, reflexed in the middle part. Length, 0.013 mm; breadth, 0.005. Striæ 25 in 0.01 mm. Our specimens are smaller than the type from Tokyo.

STAURONEIS SMITHII Grun. var. INCISA Pant.

Stauroneis Smithii Grun. var. *incisa* Pant., FR. HUSTEDT, Bacillar. (1930), 261, fig. 421.

Valve lanceolate-elliptical. Margins not undulate. Length, 0.032 mm; breadth, 0.0068. Reported from Kizaki Lake.

NAVICULA MUTICA Kütz. var. NIPPONICA var. nov. Plate 4, fig. 10.

Valve elliptical with broad ends. Length, 0.032 mm; breadth. 0.01. Striæ 18 in 0.01 mm. Puncta 20 in 0.01 mm. Differs from the type in its broad valve and cuneate ends. Uncommon.

NAVICULA PUPULA Kütz. var. CAPITATA Hustedt.

Navicula pupula Kütz. var. *capitata* HUSTEDT, Bacillar. (1930) 281, fig. 467*c*.

Valve linear, slightly undulate, at the ends capitate. Length, 0.039 mm; breadth, 0.009. Reported from Kizaki Lake.

NAVICULA PUPULA Kütz. var. RECTANGULARIS (Greg.) Grun.

Navicula pupula Kütz. var. *rectangularis* (Greg.) Grun., FR. HUSTEDT, Bacillar. (1930) 281, fig. 467*b*.

Valve linear-rectangular, ends broad. Length, 0.059 mm; breadth, 0.012. Common. Reported from Kizaki Lake.

NAVICULA LAMBDA Cleve var. NIPPONICA var. nov. Plate 6, fig. 15.

Valve linear with parallel margins, broad with obtuse ends. Length, 0.044 to 0.068 mm; breadth, 0.01 to 0.014. Median line in a thick siliceous rib. Central area broad. Striæ radiate, 12 to 13 in the middle, 15 to 18 at the ends, in 0.01 mm. The type has constricted valves and is known from Demerara River, South America.

NAVICULA SUBHAMULATA Grun. Plate 2, fig. 10.

Navicula subhamulata Grun., FR. HUSTEDT, Bacillar. (1930) 282, fig. 468*a*.

Valve linear-elliptical with broad rounded ends. Length, 0.012 mm; breadth, 0.005. Striæ slightly radiate, 25 in 0.01 mm. Axial area very narrow. Median line curved at the ends. Not common. A fresh-water species.

NAVICULA SUBHAMULATA Grun. var. PARALLELA var. nov. Plate 5, fig. 11.

Valve broad-linear with parallel margins and broad, rounded, and obtuse ends. Length, 0.017 mm; breadth, 0.005. Striæ 18 to 20 in 0.01 mm. Median line straight. Axial area narrow. Differs from variety *undulata* Hust. in its parallel margins and wider striæ. Uncommon.

NAVICULA CRUCICULA (W. Smith) Donkin var. OBTUSATA Grun. Plate 8, fig. 9.

Navicula crucicula (W. Smith) Donkin var. *obtusata* Grun., FR. HUSTEDT, Bacillar. (1930) 284.

Valve broad-lanceolate with slightly attenuate ends. Length, 0.027 mm; breadth, 0.01. Striæ radiate, 24 in the middle, 30 at the ends, in 0.01 mm. Axial area narrow, central area somewhat dilated in the middle part. Uncommon. A brackish-water diatom.

NAVICULA ATOMUS (Naegeli) Grun.

Navicula atomus (Naegeli) Grun., FR. HUSTEDT, Bacillar. (1930) 288, fig. 484.

Valve elliptical with rounded ends. Length, 0.0085 mm; breadth, 0.0042. Striæ 25 in 0.01 mm. Common in fresh water.

NAVICULA PSEUDOSCUTIFORMIS Hust.

Navicula pseudoscutiformis HUSTEDT, Bacillar. (1930) 291, fig. 495.

Valve broad-elliptical, almost round, with broad rounded ends. Length, 0.012 mm; breadth, 0.01. Axial area very narrow, central area somewhat dilated. Median line straight. Striæ radiate, in the middle alternately longer and shorter. Common in northern Europe. Reported from Kizaki Lake.

NAVICULA CRYPTOCEPHALA Kütz.

Navicula cryptocephala Kütz., FR. HUSTEDT, Bacillar. (1930) 295, fig. 496.

Valve lanceolate with attenuate ends. Length, 0.019 to 0.025 mm; breadth, 0.0042 to 0.005. Axial area narrow, widened in the middle part. Striæ radiate, 15 to 18 in 0.01 mm. Not common. Reported from Kizaki Lake.

NAVICULA RHYNCHOCEPHALA Kütz.

Navicula rhynchocephala Kütz., FR. HUSTEDT, Bacillar. (1930) 296, fig. 501.

Valve lanceolate with long ends. Length, 0.039 mm; breadth, 0.01. Central area broad. Striæ radiate, 13 to 14 in 0.01 mm. Not common. Reported from Aokiko and Kizaki Lakes.

NAVICULA ROSTELLATA Kütz. var. BIWENSIS var. nov. Plate 3, fig. 14.

Valve lanceolate with gradually attenuate ends. Length, 0.025 to 0.027 mm; breadth, 0.005. Axial area narrow. Central area dilated. Striæ 11 to 15 in 0.01 mm. Differs from the type in its regular lanceolate valves and coarser striæ. Uncommon.

NAVICULA COSTULATA Grun. fo. CURTA fo. nov. Plate 5, fig. 13.

Valve broad, rhomboid-lanceolate. Length, 0.009 mm; breadth, 0.0042. Striæ robust, radiate, 10 in 0.01 mm. Central area a broad rectangular stauros. Our specimens are shorter than the type. *Navicula costulata* is known from the bottoms of European lakes.

NAVICULA COSTULATA Grun. var. NIPPONICA var. nov. Plate 5, fig. 12.

Valves rhomboid-lanceolate with subrostrate ends. Length, 0.012 mm; breadth, 0.0042. Striæ robust, almost parallel, 9 in

0.01 mm. Differs from the type in its subrostrate ends. Common.

NAVICULA COSTULATA Grun. var. TENUIROSTRIS var. nov. Plate 5, fig. 16.

Valve lanceolate, undulate at the middle, long-attenuate at the ends. Length, 0.027 mm; breadth, 0.007. Costæ radiate, 6 in 0.01 mm. Central area a wide stauros. Differs from the type in its elongate ends. Uncommon.

NAVICULA RADIOSA Kütz. fo. NIPPONICA fo. nov. Plate 2, fig. 2; Plate 3, fig. 20.

Valve narrow-lanceolate, gradually attenuate, acuminate. Length, 0.04 to 0.042 mm; breadth, 0.0068 to 0.0085. Axial area narrow, linear, dilated in the middle. Striæ radiate, not lineolate, 8 to 11 in 0.01 mm. Differs from the type in its narrower valves. The type is known from Aokiko Lake.

NAVICULA PEREGRINA (Ehr.) Kütz. var. NIPPONICA var. nov. Plate 4, fig. 8.

Valve lanceolate, parallel in the middle part with abruptly attenuate ends. Length, 0.066 mm; breadth, 0.012. Striæ radiate, lineolate, 6 to 8 in 0.01 mm. Central area broad. Differs from the type in its parallel margins and abruptly attenuate ends. Not common.

NAVICULA MENISCULUS Schum. Plate 4, fig. 7; Plate 6, fig. 13.

Valve elliptical-lanceolate, broad in the middle and gradually attenuate towards the ends. Length, 0.027 to 0.042 mm; breadth, 0.01 to 0.012. Striæ radiate, lineolate, in the middle alternately longer and shorter, 8 to 11 in 0.01 mm. Common. Reported from Kizaki Lake.

NAVICULA REINHARDTII Grun.

Navicula Reinhardtii Grun., FR. HUSTEDT, Bacillar. (1930) 301, fig. 519.

Valve elliptical with broad, obtuse ends. Length, 0.051 mm; breadth, 0.015. Striæ radiate, lineolate, 7 to 8 in 0.01 mm. Not common. A fresh-water species.

NAVICULA FALAISIENSIS Grun. var. NIPPONICA Skvortzow. Plate 3, fig. 3.

Navicula falaisiensis Grun. var. *nipponica* SKVORTZOW, Diatoms Kizaki Lake (1936) pl. 6, fig. 15.

Valve linear-lanceolate with parallel margins and subrostrate ends. Length, 0.015 mm; breadth, 0.005. Axial area almost round. Striæ slightly radiate, 18 in 0.01 mm. Differs from the type in its short valves. Reported from Kizaki Lake.

NAVICULA DICEPHALA (Ehr.) W. Smith var. NEGLECTA (Krasske) Hust. Plate 2, fig. 22.

Navicula dicephala (Ehr.) W. Smith var. *neglecta* (Krasske) HUSTEDT, Bacillar. (1930) 303, fig. 527.

Valve broad-linear, or linear-lanceolate, triundulate with rostrate ends. Length, 0.018 mm; breadth, 0.0068. Striæ radiate, 15 in 0.01 mm. Central area rectangular. The type was reported from Aokiko Lake. Uncommon.

NAVICULA PLACENTULA (Ehr.) Grun. Plate 7, fig. 7.

Navicula placentula (Ehr.) Grun., FR. HUSTEDT, Bacillar. (1930) 303, fig. 532.

Valve elliptical-lanceolate with rostrate ends. Length, 0.027 mm; breadth, 0.0085. Striæ radiate, not punctulate, 9 to 10 in 0.01 mm. Rare.

NAVICULA PLACENTULA (Ehr.) Grun. fo. ROSTRATA A. Mayer.

Navicula placentula (Ehr.) Grun. fo. *rostrata* A. Mayer, FR. HUSTEDT, Bacillar. (1930) 303–304, fig. 533.

Valve elliptical-lanceolate with rostrate ends. Length, 0.04 mm; breadth, 0.017. Striæ 10 in 0.01 mm. Reported from Kizaki Lake.

NAVICULA GASTRUM Ehr. fo. NIPPONICA fo. nov. Plate 8, fig. 8.

Valve broad elliptical-lanceolate with rostrate ends. Length, 0.29 mm; breadth, 0.01. Striæ radiate, 10 to 11 in 0.01 mm, in the middle alternately longer and shorter. Differs from the type in its rostrate ends. Not common.

NAVICULA EXIGUA (Greg.) O. Müll.

Navicula exigua (Greg.) O. Müll., FR. HUSTEDT, Bacillar. (1930) 305, fig. 538.

Valve elliptical-lanceolate with abruptly attenuate and capitate ends. Length, 0.02 mm; breadth, 0.006. Striæ radiate, in the middle alternately longer and shorter, 15 in 0.01 mm. Reported from Aokiko and Kizaki Lakes.

NAVICULA LANCEOLATA (Agardh) Kütz. var. NIPPONICA var. nov. Plate 2, fig. 18; Plate 7, fig. 5.

Valve narrow, lanceolate, gradually attenuate. Length, 0.056 to 0.091 mm; breadth, 0.0068 to 0.01. Striæ 10 to 11 in 0.01 mm. Differs from the type in its narrow valves. *Navicula lanceolata* is known from Aokiko Lake.

NAVICULA LANCEOLATA (Agardh) Kütz. var. CYMBULA (Donk.) Cleve.

Navicula lanceolata (Agardh) Kütz. var. *cymbula* (Donk.) Cleve, VAN HEURCK, Synopsis (1880–1881) pl. 7, fig. 32.

Valve lanceolate with long-acuminate ends. Length, 0.051 mm; breadth, 0.01. Striæ in the middle 8, at the ends 10, in 0.01 mm. Known from Kizaki Lake. Common in Biwa Lake.

NAVICULA HASTA Pant.

Navicula hasta Pant., FR. HUSTEDT, Bacillar. (1930) 306, fig. 541; SKVORTZOW, Diatoms Kizaki Lake (1936) pl. 5, fig. 1.

Valve lanceolate with attenuate and slightly enlarged ends. Length, 0.127 mm; breadth, 0.018. Striæ 6 in 0.01 mm. Very common in Biwa Lake. Known from Europe, as a fossil in Hungary, and from Aokiko and Kizaki Lakes, Nippon.

NAVICULA HASTA Pant. var. GRACILIS var. nov. Plate 7, fig. 9.

Valve with long-attenuate ends. Length, 0.051 mm; breadth, 0.01. Striæ radiate, lineolate, 9 in 0.01 mm. Differs from the type in its gradually attenuate ends and smaller size. A form related to *Navicula lanceolata* var. *cymbula*. Not common.

NAVICULA UNDULATA sp. nov. Plate 4, fig. 2; Plate 7, fig. 6.

Valve elliptical-lanceolate, triundulate with attenuate ends. Length, 0.054 to 0.064 mm; breadth, 0.013 to 0.015. Striæ radiate, lineolate, 7 to 8 in 0.01 mm. Axial area narrow, central area rounded. A species related to *Navicula hasta* Pant.

NAVICULA TUSCULA (Ehr.) Grun. var. DENSISTRIATA var. nov. Plate 4, fig. 9.

Valve elliptical, attenuate and capitate. Length, 0.024 to 0.025 mm; breadth, 0.007 to 0.01. Striæ crossed by four, broad, longitudinal, undulate bands, 20 to 24 in 0.01 mm. Differs from the type in its coarser striæ. Uncommon.

NAVICULA PUSIO Cleve.

Navicula Pusio CLEVE, Synopsis Navicul. Diatom. (1885) 9, pl. 2, fig. 3.

Valve elliptical with broad rostrate ends. Length, 0.017 mm; breadth, 0.0076. Striæ fine, about 24 to 28 in 0.01 mm. Common. Known from Rotorua Lake, New Zealand, and Aokiko and Kizaki Lakes, Nippon.

NAVICULA PUSIO Cleve fo. MINUTA fo. nov.

Differs from the type in its smaller size. Length, 0.01 mm; breadth, 0.0034. Rare.

NAVICULA SIMILIS Krasske var. **NIPPONICA** var. nov. Plate 3, fig. 2.

Valve broad-elliptical with broad rostrate ends. Length, 0.018 mm; breadth, 0.0068. Striæ radiate, in the middle of unequal length, 17 to 18 in 0.01 mm. Central area almost rectangular. Differs from the type in its striæ of unequal length in the middle part of the valve. Rare.

NAVICULA PALEA Skvortzow.

Navicula palea SKVORTZOW, Diatoms Kizaki Lake (1936) pl. 8, fig. 4.

Valve linear, lanceolate, narrow, attenuate with slightly capitate ends. Length, 0.025 mm; breadth, 0.0045. Striæ radiate, 15 in 0.01 mm. Known from Kizaki Lake.

NAVICULA SCUTELLOIDES W. Sm. Plate 2, fig. 1.

Navicula scutelloides W. Sm., A. SCHMIDT, Atlas Diatom. (1875) pl. 6, fig. 34.

Valve broad-elliptical with broad rounded ends. Length, 0.015 to 0.02 mm; breadth, 0.011 to 0.014. Median line straight. Axial area somewhat dilated in the middle. Striæ radiate in the border, of unequal length, 10 to 15 in 0.01 mm; puncta distinct, 18 in 0.01 mm. Rare. A distinct species by the structure of the valve, related to *Cocconeis pliocaenica* Krasske, known from the Upper Pliocene of Germany.

NAVICULA SOODENSIS Krasske. Plate 5, fig. 8.

Navicula soodensis Krasske, FR. HUSTEDT, Bacillar. (1930) 276, fig. 457.

Valve linear-elliptical with almost parallel margins and obtuse ends. Length, 0.023 mm; breadth, 0.005. Striæ slightly radiate, 18 in 0.01 mm. Median line filiform, straight. Axial area very narrow. Central area a broad rectangular stauros. The type is known from brackish water in Europe.

NAVICULA KAWAMURÆ sp. nov. Plate 5, fig. 10.

Valve lanceolate, undulate at the middle, abruptly attenuate at the ends. Length, 0.027 mm; breadth, 0.0045. Striæ parallel, 18 to 20 in 0.01 mm. Axial area a broad fascia, reaching one-third of the valve length. Not common. Named in honor of Prof. Dr. T. Kawamura, of Kyoto.

NAVICULA MINUTA sp. nov. Plate 3, fig. 17.

Valve rhombic-elliptic, broad and acute. Length, 0.015 mm; breadth, 0.005. Striæ parallel, 24 in 0.01 mm. Median line straight. Axial area linear, slightly enlarged. Central area a broad fascia, reaching about one-third of the valve length. Belongs to Naviculæ lineolatæ Cleve. Not common.

NAVICULA ACHNANTHOIDES sp. nov. Plate 7, fig. 8.

Valve lanceolate-elliptical, with parallel margins, and gradually attenuate towards the ends. Length, 0.049 mm; breadth, 0.01. Median line straight, not reaching the ends. Axial area linear, central area broad and orbicular. Striæ 11 to 12 in the middle, 16 to 17 at the ends, in 0.01 mm. Both ends with transverse, rounded, siliceous ribs. Uncommon.

NAVICULA NIPPON sp. nov. Plate 5, fig. 17.

Valve elliptical or rhomboidal with parallel margins and broad rostrate ends. Length, 0.024 mm; breadth, 0.0068. Median line straight, central pores curved in the same direction. Axial area narrow, central area a broad, widened, rectangular stauros. Striæ slightly radiate, divergent in the middle, convergent at the ends. Common.

PINNULARIA UNDULATA Greg. var. **NIPPONICA** var. nov. Plate 4, fig. 12; Plate 8, fig. 2.

Valve lanceolate-elliptical with triundulate, attenuate, and rounded ends. Length, 0.04 to 0.068 mm; breadth, 0.0068 to 0.01. Striæ 18 in 0.01 mm. Axial area narrow, central area a broad stauros. Differs from variety *subundulata* Grun. in its broad stauros.

PINNULARIA MOLARIS Grun.

Pinnularia molaris Grun., FR. HUSTEDT, Bacillar. (1930) 316, fig. 568.

Valve linear or linear-lanceolate with slightly attenuate and rounded ends. Length, 0.02 mm; breadth, 0.005. Striæ 18 in 0.01 mm. Central area a broad stauros. Common. Reported from Kizaki Lake.

PINNULARIA INTERRUPTA W. Smith.

Pinnularia interrupta W. Smith, FR. HUSTEDT, Bacillar. (1930) 317, fig. 573.

Valve linear with parallel margins and capitate ends. Length, 0.04 mm; breadth, 0.0068. Striæ divergent in the middle and convergent at the ends, 10 to 11 in 0.01 mm. Common. Known from fresh water.

PINNULARIA BRAUNII (Grun.) Cleve var. **AMPHICEPHALA** (A. Mayer) Hust. fo. **NIPPONICA** fo. nov. Plate 2, fig. 20.

Valve elliptical-lanceolate with capitate ends. Length, 0.034 mm; breadth, 0.0068. Striæ 15 in 0.01 mm. Differs from the type in its slightly constricted margins. Uncommon.

PINNULARIA BRAUNII (Grun.) Cleve var. **NIPPONICA** var. nov. Plate 5, fig. 3.

Valve elliptical-lanceolate with parallel margins and rostrate obtuse ends. Length, 0.032 mm; breadth, 0.006. Striæ 15 in

0.01 mm. Differs from variety *amphicephala* in its rostrate and capitate ends. Uncommon.

PINNULARIA POLYONCA (Breb.) O. Müll. var. NIPPONICA var. nov. Plate 6, fig. 3.

Valve lanceolate with triundulate margins. Ends subtruncate. Length, 0.047 mm; breadth, 0.0075. Striæ radiate, 11 to 12 in 0.01 mm. Differs from the type in having narrow, not capitate, ends and a broad middle part. Uncommon.

PINNULARIA KARELICA Cleve var. JAPONICA Hust.

Pinnularia karelica Cleve var. *japonica* HUSTEDT, Bacillar. aus dem Aokikosee in Japan 165, pl. 5, fig. 3.

Valve linear, slightly enlarged in the middle part, rounded and capitate at the ends. Length, 0.051 mm; breadth, 0.012. Reported from Aokiko and Kizaki Lakes.

PINNULARIA PLATYCEPHALA (Ehr.) Cleve var. HATTORIANA Meister.

Pinnularia platycephala (Ehr.) Cleve var. *Hattoriana* MEISTER, Beiträge zur Bacillar. Japans. (1914) 2, 228–229, pl. 8, figs. 6, 7.

Valve linear, triundulate with capitate ends. Length, 0.074 mm; breadth, 0.009. Striæ radiate, interrupted in the middle part, 9 in 0.01 mm. Reported from Tokyo, Kizaki Lake, in Nippon; from Poyang Lake, Hunan, China; and from Battater, Scotland.

PINNULARARIA PLATYCEPHALA (Ehr.) Cleve var. HATTORIANA Meister fo. ANGUSTIOR fo. nov. Plate 7, fig. 3.

Valve linear, 5-undulate with subtruncate ends. Length, 0.081 mm; breadth, 0.01. Striæ radiate, 8 in 0.01 mm. Differs from variety *Hattoriana* in its narrower valves. Uncommon.

PINNULARIA BOREALIS Ehr.

Pinnularia borealis Ehr., FR. HUSTEDT, Bacillar. (1930) 326, fig. 597.

Valve linear or linear-elliptical with broad rounded ends. Length, 0.034 mm; breadth, 0.008. Common. Reported from Kizaki Lake.

PINNULARIA GIBBA Ehr. Plate 5, fig. 2.

Pinnularia gibba Ehr., FR. HUSTEDT, Bacillar. (1930) 327, fig. 600.

Valve linear-lanceolate with slightly apiculate apex. Length, 0.056 to 0.058 mm; breadth, 0.0076 to 0.0085. Striæ radiate, 9 in 0.01 mm. Common. Reported from Kizaki Lake.

PINNULARIA GIBBA Ehr. var. BIWENSIS var. nov. Plate 2, fig. 6.

Valve broad with slightly capitate and attenuate apex. Length, 0.066 mm; breadth, 0.009. Striæ divergent in the middle, convergent at the ends, 11 to 12 in 0.01 mm. Median line

with long, terminal, reflexed fissures. Differs from variety *nipponica* Skv. by its capitate ends.

PINNULARIA ACROSPHÆRIA Breb. var. LÆVIS Cleve.

Pinnularia acrosphæria A. SCHMIDT, Atlas Diatom. (1876) pl. 43, fig. 18.

Valve linear, more or less gibbous in the middle and at the ends. Length, 0.061 mm; breadth, 0.01. Axial area broad, hyaline. Striæ 9 to 10 in 0.01 mm. Known from New Zealand and from the Blue Mountains, Australia.

PINNULARIA MACILENTA Ehr. Cleve.

Pinnularia macilenta Ehr. Cleve, FR. HUSTEDT, Bacillar. (1930) 331, fig. 613.

Valve linear with parallel margins and broad rounded ends. Length, 0.183 mm; breadth, 0.025. Costæ almost parallel, 5 in 0.01 mm. Known from Europe.

PINNULARIA MAJOR (Kütz.) Cleve var. LINEARIS Cleve.

Pinnularia major (Kütz.) Cleve var. *linearis* Cleve, FR. HUSTEDT, Bacillar. (1930) 331; PANTOCSEK, Fossile Bacillar. Ungarns (1903) 3, pl. 7, fig. 113.

Valve linear with broad rounded ends. Length, 0.161 mm; breadth, 0.022. Striæ 6 in 0.01 mm. Axial area enlarged. Central area outwardly dilated. Common. Reported from Kizaki Lake.

PINNULARIA MAJOR (Kütz.) Cleve var. NIPPONICA var. nov. Plate 8, fig. 6.

Valve linear with parallel margins and abruptly attenuate and subrostrate ends. Length, 0.153 mm; breadth, 0.017. Striæ radiate, divergent in the middle, convergent at the ends, 6 in 0.01 mm. Differs from the type in its subrostrate and narrower valves. Uncommon.

PINNULARIA VIRIDIS (Nitzsch) Ehr. var. FALLAX Cleve. Plate 8, fig. 11.

Pinnularia viridis (Nitzsch) Ehr. var. *fallax* Cleve, FR. HUSTEDT, Bacillar. (1930) 335.

Valve linear, obtuse at the ends. Length, 0.042 to 0.052 mm; breadth, 0.01 to 0.013. Striæ 8 to 9 in 0.01 mm. Striæ from one side of the valve abrupt. Reported from Kizaki Lake.

PINNULARIA VIRIDIS (Nitzsch) Ehr. var. LEPTOGONGYLA (Ehr. Grun.) Cleve. Plate 6, fig. 10.

Pinnularia viridis (Nitzsch) Ehr. var. *leptogongyla* (Ehr. Grun.) Cleve, FR. HUSTEDT, Bacillar. (1930) 335.

Valve linear with broad rounded ends. Length, 0.051 mm; breadth, 0.012. Striæ 9 to 10 in 0.01 mm. Central area broadly rounded. Not common. Reported from Kizaki Lake.

PINNULARIA NAKAII sp. nov. Plate 8, fig. 4.

Valve lanceolate-linear, in the middle slightly undulate, gradually attenuate towards the ends. Ends slightly capitate, acuminate. Length, 0.99 mm; breadth, 0.012. Median line straight with large, comma-shaped, terminal fissures. Axial area narrow-linear, broadened towards the central area. Central area a broad stauros, truncate outwards. Costæ radiate, divergent in the middle, convergent at the ends, without a longitudinal band. Not common. Named in honor of Prof. Dr. T. Nakai, of Tokyo.

PINNULARIA CUCUMIS sp. nov. Plate 8, fig. 3.

Valve broad-linear, almost rectangular, with broad rounded ends. Length, 0.105 mm; breadth, 0.02. Median line filiform, with strong, curved, terminal fissures. Axial area linear, dilated from both sides. Central area round. Striæ curved, divergent in the middle, convergent at the ends, 7 to 9 in 0.01 mm, with two longitudinal lines. Common.

PINNULARIA STRIATULA sp. nov. Plate 5, fig. 6.

Valve linear-lanceolate with parallel margins, slightly attenuate, and with broad rounded ends. Length, 0.054 mm; breadth, 0.0068. Median line linear, terminal fissures comma-shaped. Axial area very narrow, central areas slightly dilated. Striæ parallel, striolate, 11 to 12 in 0.01 mm. Uncommon.

PINNULARIA LACUS BIWA sp. nov. Plate 6, fig. 8.

Valve elliptical-lanceolate with capitate ends. Length, 0.085 mm; breadth, 0.018. Median line straight, with large comma-shaped terminal fissures. Axial area broad, passing into a broad central area, forming a stauros, truncate outwards. Striæ divergent in the middle, convergent at the ends, 9 in 0.01 mm. Longitudinal lines absent. Common.

PINNULARIA KAWAMURÆ sp. nov. Plate 7, fig. 12.

Valve elliptical-lanceolate, middle part undulate, gradually attenuate towards the ends. Length, 0.088 mm; breadth, 0.018. Median line filiform, enlarged in the middle part. Axial areas broad, passing into a broad central area, forming a broad truncate stauros. Striæ radiate, 8 to 9 in 0.01 mm, with two longitudinal bands. Named in honor of Prof. Dr. T. Kawamura, of Kyoto.

PINNULARIA NIPPONICA Skvortzow. Plate 3, fig. 8; Plate 8, fig. 5.

Pinnularia nipponica SKVORTZOW, Diatoms Kizaki Lake (1936) pl. 7, fig. 12.

Valve linear-lanceolate, constricted in the middle, attenuate and subrostrate at the ends. Length, 0.068 to 0.076 mm; breadth, 0.012 to 0.013. Costæ divergent in the middle and convergent at the ends, forming a stauros in the middle part. Median line filiform, with comma-shaped terminal fissures. Longitudinal bands distinct. Common. A species related to *Pinnularia esox* Ehr. Reported from Kizaki Lake.

AMPHORA OVALIS Kütz.

Amphora ovalis Kütz., FR. HUSTEDT, Bacillar. (1930) 342, fig. 628.

Valve broad-elliptical with curved axial area. Length, 0.051 mm; breadth, 0.018. Not common. Reported from Aokiko Lake.

AMPHORA OVALIS Kütz. var. **LIBYCA** (Ehr.) Cleve. Plate 6, fig. 7.

Amphora ovalis Kütz. var. *libyca* (Ehr.) Cleve, A. SCHMIDT, Atlas Diatom. (1875) pl. 26, fig. 105.

Differs from the type in its narrow valves. Length, 0.032 to 0.064 mm; breadth, 0.007 to 0.025. Striæ 10 to 12 in 0.01 mm. Reported from Kizaki Lake.

AMPHORA OVALIS Kütz. var. **PEDICULUS** Kütz.

Amphora ovalis Kütz. var. *pediculus* Kütz., FR. HUSTEDT, Bacillar. (1930) 343, fig. 629.

Valve very small. Length, 0.013 mm; breadth, 0.004. Striæ 15 in 0.01 mm. Known from Aokiko and Kizaki Lakes.

AMPHORA PERPUSILLA Grun.

Amphora perpusilla Grun., FR. HUSTEDT, Bacillar. (1930) 343, fig. 627.

Valve elliptical, slightly siliceous. Length, 0.0085 mm; breadth, 0.002. Striæ 22 in 0.01 mm. Reported from Kizaki Lake.

AMPHORA DELPHINEA (Bailey) A. S. var. **MINOR** Cleve.

Amphora delphinea (Bailey) A. S. var. *minor* CLEVE, Synopsis Navicul. Diatom. (1895) 2, 134; A. SCHMIDT, Atlas Diatom. (1876) pl. 40, fig. 25; SKVORTZOW, Diatoms Kizaki Lake (1936) pl. 3, fig. 12.

Frustule elliptical-rectangular. Length, 0.057 mm; breadth, 0.017. This American species is not common in Biwa Lake. Found also in Kizaki Lake.

CYMBELLA CUSPIDATA Kütz.

Cymbella cuspidata Kütz., A. SCHMIDT, Atlas Diatom. (1875) pl. 9, figs. 50, 53–55.

Valve broad, linear-lanceolate with abruptly attenuate ends. Length, 0.049 to 0.054 mm; breadth, 0.012 to 0.02. Striæ 9 to 11 in 0.01 mm. Common. Reported from Kizaki Lake.

CYMBELLA PROSTATA (Berkeley) Cleve.

Cymbella prostata (Berkeley) Cleve, VAN HEURCK, Synopsis (1880–1881) 65, pl. 3, figs. 9–11.

Valve boat-shaped with gibbous dorsal and slightly concave ventral margins. Length, 0.051 mm; breadth, 0.015. Striæ, dorsal 7, ventral 8, in 0.01 mm. A species typical of Arctic and alpine regions. Reported from Aokiko and Kizaki Lakes.

CYMBELLA HETEROPLEURA Ehr. var. MINOR Cleve.

Cymbella sp., A. SCHMIDT, Atlas Diatom. (1875) pl. 9, figs. 51, 52.

Valve with rostrate and truncate ends. Length, 0.062 mm; breadth, 0.018. Striæ 8 in 0.01 mm. An Arctic diatom known from Spitsbergen, Beeren Island, Norway, Scotland, Siberia, and Aokiko Lake.

CYMBELLA HYBRIDA Grun.

Cymbella hybrida Grunow, SKVORTZOW, Diatoms Kizaki Lake (1936) pl. 5, fig. 23.

Valve naviculiform with truncate ends. Length, 0.06 to 0.074 mm; breadth, 0.0085 to 0.01. Striæ lineolate, 8 in 0.01 mm. Reported from Kizaki Lake. Common in Biwa Lake.

CYMBELLA TUMIDA (Breb.) Van Heurck.

Cymbella tumida (Breb.) Van Heurck, FR. HUSTEDT, Bacillar. (1930) 366, fig. 677.

Valve cymbiform with rostrate ends. Striæ divergent in the middle, convergent at the ends. Length, 0.045 mm; breadth. 0.015. Not common. Reported from Aokiko and Kizaki Lakes.

CYMBELLA TUMIDA (Breb.) Van Heurck var. BOREALIS Grun.

Cymbella tumida (Breb.) van Heurck var. *borealis* Grun., SKVORTZOW, Diatoms Kizaki Lake (1936) pl. 11, fig. 16.

Differs from the type in the valve being not attenuate at the ends. Length, 0.072 mm; breadth, 0.019. Reported from Aokiko and Kizaki Lakes.

CYMBELLA CISTULA (Hemprich) Grun.

Cymbella cistula (Hemprich) Grun., FR. HUSTEDT, Bacillar. (1930) 363, fig. 676*a*.

Valve lunate, undulate. Length, 0.062 to 0.068 mm; breadth, 0.012 to 0.013. Striæ 8 to 10 in 0.01 mm. Near the central nodule the striæ are interrupted by two puncta. Known from Aokiko and Kizaki Lakes.

CYMBELLA SINUATA Greg.

Cymbella sinuata Greg., FR. HUSTEDT, Bacillar. (1930) 361, fig. 668*a*, *b*.

Valve asymmetrical, lanceolate, obtuse. Length, 0.012 mm; breadth, 0.034. Striæ 15 in 0.01 mm. Reported from Aokiko and Kizaki Lakes.

CYMBELLA VENTRICOSA Kütz.

Cymbella ventricosa Kütz., FR. HUSTEDT, Bacillar. (1930) 359, fig. 661.

Valve asymmetrical with acute ends. Length, 0.028 mm; breadth, 0.007. Striæ 9 in 0.01 mm. Also reported from Aokiko and Kizaki Lakes.

CYMBELLA TUMIDULA Grun.

Cymbella tumidula Grun., A. SCHMIDT, Atlas Diatom. (1931) pl. 376, figs. 14–16.

Valve broad-elliptical with rostrate, slightly acuminate ends. Length, 0.034 mm; breadth, 0.01. Striæ 10 to 11 in 0.01 mm. Near the central nodule two isolated puncta. Common in Biwa Lake. Known from tropical districts.

CYMBELLA TURGIDULA Grun. var. NIPPONICA var. nov. Plate 2, fig. 8; Plate 4, fig. 4.

Valve boat-shaped with rostrate ends. Median line arcuate. Length, 0.037 mm; breadth, 0.01. Striæ 10 in 0.01 mm. Near the central area two isolated puncta. Differs from the type in its elongate valve, slightly undulate ventral margin, and broad rostrate ends. Common.

CYMBELLA LATA Grun. var. NIPPONICA var. nov. Plate 3, fig. 6.

Valve asymmetrical with subrostrate ends. Length, 0.039 mm; breadth, 0.012. Striæ robust, 10 in 0.01 mm. Differs from the type in its asymmetrical valve and undulate dorsal margin. Not common.

CYMBELLA NIPPONICA sp. nov. Plate 5, figs. 20 and 23.

Valve broad-elliptical with undulate margin and rostrate or subrostrate ends. Length, 0.029 mm; breadth, 0.013 to 0.015.

Striæ robust, radiate, striolate, in the middle alternately longer and shorter with one isolated punctum, 8 to 12 in 0.01 mm. Uncommon.

DIDYMOSPHENIA GEMINATA (Lyngb.) M. Schmidt. Plate 8, fig. 10.

Didymosphenia geminata (Lyngb.) M. Schmidt, FR. HUSTEDT, Bacillar. (1930) 367, fig. 682.

Valve clavate, robust. Length, 0.132 mm; breadth, 0.04. Rare. Common in alpine regions.

GOMPHONEMA PARVULUM (Kütz.) Grun.

Gomphonema parvulum (Kütz.) Grun., FR. HUSTEDT, Bacillar. (1930) 372, fig. 713*a*.

Valve lanceolate-attenuate towards the ends. Length, 0.02 mm; breadth, 0.005. Striæ 12 in 0.01 mm. Known from Kizaki Lake.

GOMPHONEMA PARVULUM (Kütz.) Grun. var. EXILISSIMA Grun. Plate 2, fig. 13.

Gomphonema parvulum (Kütz.) Grun. var. *exilissima* Grun., VAN HEURCK, Synopsis (1880–1881) pl. 25, fig. 12.

Valve narrower than that of the type. Length, 0.015 to 0.018 mm; breadth, 0.005 to 0.006. Striæ 15 in 0.01 mm. Isolated puncta indistinct. Reported from Kizaki Lake.

GOMPHONEMA BERGGRENII Cleve. Plate 5, fig. 22.

Gomphonema Berggrenii Cleve, A. SCHMIDT, Atlas Diatom. (1902) pl. 240, fig. 28.

Valve elliptical, clavate, with capitate apex, broad middle part, attenuate towards the end. Length, 0.035 mm; breadth, 0.008. Striæ 8 in 0.01 mm. Reported from New Zealand and Kizaki Lake.

GOMPHONEMA ACUMINATUM Ehr. var. CORONATA (Ehr.) W. Smith.

Gomphonema acuminatum Ehr. var. *coronata* (Ehr.) W. Smith., FR. HUSTEDT, Bacillar. (1930) 370, fig. 684.

Valve clavate, biconstricted with apiculate apex. Length, 0.072 mm; breadth, 0.011. Not common. Known from Kizaki Lake.

GOMPHONEMA CONSTRICTUM Ehr. var. CAPITATA (Ehr.) Cleve.

Gomphonema constrictum Ehr. var. *capitatum* (Ehr.) Cleve, FR. HUSTEDT, Bacillar. (1930) 377, fig. 715.

Valve clavate with broad apex. Length, 0.03 to 0.042 mm; breadth, 0.0085. Striæ 12 to 14 in 0.01 mm. Reported from Aokiko and Kizaki Lakes.

GOMPHONEMA INTRICATUM Kütz.

Gomphonema intricatum Kütz., FR. HUSTEDT, Bacillar. (1930) 375, fig. 697.

Valve clavate, elongate, apex slightly capitate, middle little undulate. Length, 0.028 mm; breadth, 0.004. Reported from Kizaki Lake.

GOMPHONEMA INTRICATUM Kütz. var. PUMILA Grun. Plate 3, fig. 12.

Gomphonema intricatum Kütz. var. *pumila* Grun., FR. HUSTEDT, Bacillar. (1930) 375, fig. 699.

Valve minute, lanceolate with attenuate and rounded ends. Length, 0.015 mm; breadth, 0.0028. Striæ 15 in 0.01 mm. Common. With the type.

GOMPHONEMA AUGUR Ehr. var. GAUTIERI Van Heurck.

Gomphonema augur Ehr. var. *Gautieri* Van Heurck, FR. HUSTEDT, Bacillar. (1930) 372, fig. 689.

Valve clavate with broad upper part and apiculate apex. End narrow. Length, 0.054 mm; breadth, 0.013. Reported from Kizaki Lake.

GOMPHONEMA LANCEOLATUM Ehr. var. INSIGNIS (Gregory) Cleve. Plate 4, fig. 6.

Gomphonema lanceolatum Ehr. var. *insignis* (Gregory) Cleve, FR. HUSTEDT, Bacillar. (1930) 376, fig. 701.

Valve lanceolate with attenuate ends. Length, 0.042 to 0.047 mm; breadth, 0.007 to 0.009. Striæ 10 in 0.01 mm. Isolated puncta distinct. Reported from Kizaki Lake. Common in Biwa Lake.

GOMPHONEMA VASTUM Hust. var. ELONGATA Skvortzow. Plate 2, fig. 17.

Gomphonema vastum Hust. var. *elongata* SKVORTZOW, Diatoms Kizaki Lake (1936) pl. 13, figs. 33, 40.

Valve elongate-lanceolate-linear with obtuse ends. Length, 0.042 mm; breadth, 0.005 to 0.006. Striæ marginal, 8 to 9 in 0.01 mm. Isolated puncta distinct. Differs from the type in its elongate valve. Not common. Known from Kizaki Lake.

GOMPHONEMA VASTUM Hust. var. MAXIMA var. nov. Plate 8, fig. 7.

Larger than the type. Length, 0.062 mm; breadth, 0.008. Striæ marginal, 15 in 0.01. Uncommon.

GOMPHONEMA LINGULATUM Hust. Plate 3, fig. 13; Plate 6, fig. 16.

Gomphonema lingulatum HUSTEDT, Bacillar. aus dem Aokikosee in Japan 166, pl. 5, fig. 5.

Valve clavate. The upper part broadly rounded and abruptly apiculate. Lower part attenuate and obtuse. Length, 0.018

mm; breadth, 0.008. Striæ marginal, 15 in 0.01 mm. Isolated puncta absent. Not common. Known from Aokiko and Kizaki Lakes.

GOMPHONEMA LINGULATUM Hust. var. ELONGATUM var. nov. Plate 3, fig. 11.

Valve elongate, slightly biconstricted, enlarged in the upper part, with apiculate apex. Length, 0.049 mm; breadth, 0.01. Striæ marginal, 13 to 14 in 0.01 mm. No isolated puncta. Not common.

GOMPHONEMA LINGULATUM Hust. var. PUMILA var. nov. Plate 2, fig. 19.

Valve minute, rounded at apex, attenuate at the end. Length, 0.01 mm; breadth, 0.005. Striæ marginal, 15 in 0.01 mm. No isolated puncta. Differs from the type in its rounded apex and small size. Not common.

EPITHEMIA ZEBRA (Ehr.) Kütz. var. PORCELLUS (Kütz.) Grun.

Epithemia zebra (Ehr.) Kütz. var. *porcellus* (Kütz.) Grun., FR. HUSTEDT, Bacillar. (1930) 385, fig. 731.

Valve slightly curved, on the ventral side almost straight, on the dorsal side undulate with rostrate-truncate ends. Length, 0.051 mm; breadth, 0.008. The type is known from Aokiko Lake.

EPITHEMIA ZEBRA (Ehr.) Kütz. var. SAXONICA (Kütz.) Grun.

Epithemia zebra (Ehr.) Kütz. var. *saxonica* (Kütz.) Grun., FR. HUSTEDT, Bacillar. (1930) 385, fig. 730.

Valve genuflexed with attenuate, subrostrate ends. Length, 0.025 to 0.037 mm; breadth, 0.0065 to 0.007. Costæ 3 to 4, striæ 13 to 14, in 0.01 mm. Common. Known from Kizaki Lake.

EPITHEMIA TURGIDA (Ehr.) Kütz. Plate 3, fig. 10.

Epithemia turgida (Ehr.) Kütz., A. SCHMIDT, Atlas Diatom. (1904) pl. 250, figs. 5, 6.

Valve robust, broad, with short rounded ends. Length, 0.056 to 0.093 mm; breadth, 0.014 to 0.017. Costæ 4 in 0.01 mm. Common. Known from fresh water.

EPITHEMIA SOREX Kütz.

Epithemia sorex Kütz., FR. HUSTEDT, Bacillar. (1930) 388, fig. 736.

Valve genuflexed, attenuate towards the capitate ends. Length, 0.037 mm; breadth, 0.0085. Reported from Aokiko and Kizaki Lakes.

EPITHEMIA SOREX Kütz. var. GRACILIS Hust. Plate 2, fig. 11.

Epithemia sorex Kütz. var. *gracilis* HUSTEDT, Bacillar. (1930) 388, fig. 737.

Valve curved, gradually attenuate towards the rounded ends. Length, 0.034 mm; breadth, 0.0055. Costæ 4, striæ 15, in 0.01 mm. Not common.

EPITHEMIA HYNDMANII W. Smith.

Epithemia Hyndmanii W. Smith, FR. HUSTEDT, Bacillar. (1930) 387, fig. 735.

Valve robust, lunate with elongate and obtuse ends. Length, 0.195 mm; breadth, 0.023. Costæ 3 in 0.01 mm. Common. Known from fresh water.

RHOPALODIA PARALLELA (Grun.) O. Müll.

Rhopalodia parallela (Grun.) O. Müll., FR. HUSTEDT, Bacillar. (1930) 389, fig. 739.

Valve linear, slightly reflexed in the middle. Length, 0.08 mm; breadth, 0.02. Common. Known from Kizaki Lake and common in alpine lakes of Europe.

RHOPALODIA GIBBA (Ehr.) O. Müll.

Rhopalodia gibba (Ehr.) O. Müll., FR. HUSTEDT, Bacillar. (1930) 390, fig. 740.

Valve linear, undulate and reflexed in the middle part. Length, 0.017 mm; breadth, 0.01. Striæ 7 in 0.01 mm. Reported from Aokiko and Kizaki Lakes.

RHOPALODIA GIBBA (Ehr.) O. Müll. var. VENTRICOSA (Ehr.) Grun.

Rhopalodia gibba (Ehr.) O. Müll. var. *ventricosa* (Ehr.) Grun., FR. HUSTEDT, Bacillar. (1930) 391, fig. 741.

Valve broad and short. Length, 0.045 mm; breadth, 0.0068. Common.

HANTZSCHIA AMPHIOXUS (Ehr.) Grun.

Hantzschia amphioxus (Ehr.) Grun., FR. HUSTEDT, Bacillar. (1930) 394, fig. 747.

Valve linear or lanceolate with subrostrate ends. Margin constricted on one side, undulate on the other. Length, 0.032 mm; breadth, 0.006. Uncommon. Reported from Kizaki Lake.

NITZSCHIA TRYBLIONELLA Hantzsch var. DEBILIS (Arnott) A. Mayer. Plate 2, fig. 24.

Nitzschia tryblionella Hantzsch var. *debilis* (Arnott) A. Mayer., FR. HUSTEDT, Bacillar. (1930) 400, fig. 759.

Valve broad-elliptical with cuneate, rounded ends. Margins parallel. Length, 0.017 mm; breadth, 0.0085. Costæ fine, 11 to 12 in 0.01 mm. Not common. Known from fresh and brackish waters.

NITZSCHIA TRYBLIONELLA Hantzsch var. VICTORIÆ Grun. Plate 6, fig. 11.

Nitzschia tryblionella Hantzsch var. *victoriæ* Grun., FR. HUSTEDT, Bacillar. (1930) 399, fig. 758.

Valve elliptical, slightly constricted. Length, 0.047 mm; breadth, 0.015. Costæ robust, 5 in 0.01 mm. Common. A brackish-water diatom.

NITZSCHIA ACUTA Hantzsch. Plate 5, fig. 4.

Nitzschia acuta Hantzsch, FR. HUSTEDT, Bacillar. (1930) 412, fig. 790.

Valve long linear-lanceolate, gradually attenuate towards the ends. Length, 0.103 mm; breadth, 0.0042. Costæ 6 in 0.01 mm. Striæ very fine and indistinct. Not common. A fresh-water species.

NITZSCHIA LORENZIANA Grun. var. SUBTILIS Grun. Plate 5, fig. 9.

Nitzschia Lorenziana Grun. var. *subtilis* Grun., A. SCHMIDT, Atlas Diatom. (1921) pl. 335, figs. 6–8.

Valve sygmoid-linear, attenuate towards the ends. Length, 0.119 mm; breadth, 0.0051. Costæ 15 in 0.01 mm. Striæ indistinct. Not common. Known from brackish water.

NITZSCHIA PALEA (Kütz.) W. Smith.

Nitzschia palea (Kütz.) W. Smith, FR. HUSTEDT, Bacillar. (1930) 416, fig. 801.

Valve linear-lanceolate with gradually attenuate and slightly capitate ends. Length, 0.0204 mm; breadth, 0.0034. Costæ 15 in 0.01 mm. Striæ very fine, indistinct. Not common. Known from Kizaki Lake.

NITZSCHIA CLAUSII Hantzsch. Plate 7, fig. 10.

Nitzschia Clausii Hantzsch, VAN HEURCK, Synopsis (1880–1881) pl. 66, fig. 10.

Valve sigmoid-linear with parallel margins and abruptly attenuate and curved ends. Length, 0.052 mm; breadth, 0.003. Costæ 10 in 0.01 mm. Striæ indistinct. Uncommon. Known from brackish water.

NITZSCHIA INTERRUPTA (Reich.) Hust.

Nitzschia interrupta (Reich.) HUSTEDT, Bacillar. aus dem Aokikosee in Japan 168.

Valve lanceolate with attenuate and capitate ends. Costæ robust, reaching about the middle part of the valve. Length, 0.029 to 0.003 mm; breadth, 0.007. Common. Known from Aokiko and Kizaki Lakes.

NITZSCHIA ACICULARIS W. Smith var. NIPPONICA Skvortzow.

Nitzschia acicularis W. Smith var. *nipponica* SKVORTZOW, Diatoms Kizaki Lake (1936) pl. 13, fig. 7.

Valve hyaline, lanceolate with long beaks. Length, 0.01 mm; breadth, 0.0025. Common. Known from Kizaki Lake.

CYMATOPLEURA SOLEA (Breb.) W. Smith.

Cymatopleura solea (Breb.) W. Smith., Fr. HUSTEDT, Bacillar. (1930) 425, fig. 823*a*.

Valve broad-linear, constricted in the middle, enlarged and cuneate at the ends. Length, 0.085 mm; breadth, 0.015. Known from Aokiko Lake.

CYMATOPLEURA ELLIPTICA (Breb.) W. Smith var. CONSTRICTA Grun.

Cymatopleura elliptica (Breb.) W. Smith var. *constricta* Grun., FR. HUSTEDT, Bacillar. (1930) 428, fig. 826.

Valve broad-elliptical, slightly constricted in the middle part and broad-cuneate at the ends. Length, 0.161 mm; breadth, 0.059. Striæ 3 in 0.01 mm. Not common.

SURIRELLA BISERIATA Breb.

Surirella biseriata Breb., FR. HUSTEDT, Bacillar. (1930) 432, figs. 331–332.

Valve linear-elliptical or lanceolate-elliptical with parallel margins and gradually attenuate at the ends. Length, 0.111 mm; breadth, 0.02. Marginal keel forming wings. Costæ robust, short, 3 in 0.01 mm, not reaching the pseudoraphe. Common. Reported from Aokiko and Kizaki Lakes.

SURIRELLA ROBUSTA Ehr. var. SPLENDIDA (Ehr.) Van Heurck.

Surirella robusta Ehr. var. *splendida* (Ehr.) Van Heurck, FR. HUSTEDT, Bacillar. (1930) 437, figs. 851–852.

Valve elongate-ovate with robust costæ and alæ. Length, 0.091 to 0.096 mm; breadth, 0.03. Common. Reported from Aokiko and Kizaki Lakes.

1321——9

SURIRELLA ROBUSTA Ehr. var. NIPPONICA var. nov. Plate 5, fig. 1.

Valve elliptical with broad ends. Length, 0.086 mm; breadth, 0.034. Costæ robust, 1.5 in 0.01 mm, covered with spines. Differs from the type in its perfect elliptical shape and the presence of spines. Uncommon.

SURIRELLA PANTOCSEKII Meister.

Surirella Pantocsekii MEISTER, Beiträge zur Bacillar. Japans. (1930) 230, pl. 8, figs. 14, 15.

Valve long-linear, gradually constricted in the middle and undulate at the ends. Length, 0.049 mm; breadth, 0.0085. Striæ 15 in 0.01 mm. Uncommon. Known from Tokyo and Kizaki Lake.

SURIRELLA TENERA Greg. var. NIPPONICA var. nov. Plate 4, fig. 1.

Differs from the type in its elongate valve, enlarged in one part, attenuate in another. Length, 0.127 mm; breadth, 0.02. Costæ 10 in 0.01 mm. Uncommon.

SURIRELLA BIWENSIS sp. nov. Plate 2, fig. 5; Plate 7, fig. 4.

Valve long-linear, constricted in the middle and slightly capitate, cuneate at the ends. Length, 0.087 to 0.2 mm; breadth, 0.013 to 0.018 in the middle, 0.022 at the ends. Costæ fine, 5 to 7 in 0.01 mm. A species related to *Surirella Alisoviana* Skv., from Hanka Lake, eastern Siberia.

SURIRELLA NIPPONICA Skvortzow. Plate 4, fig. 5.

Surirella nipponica SKVORTZOW, Diatoms Kizaki Lake (1936) pl. 8, fig. 17.

Valve lanceolate-elliptical, undulate in the middle, gradually attenuate at the ends. Length, 0.124 mm; breadth, 0.018. Costæ reaching the pseudoraphe. Marginal keel forming wings, or alæ, 2 in 0.01 mm. Striæ distinct, 24 in 0.01 mm. Very common. Known from Kizaki Lake.

SURIRELLA ELEGANS Ehr.

Surirella elegans Ehr., FR. HUSTEDT, Bacillar. (1930) 440, fig. 858.

Valve elongate-ovate. Length, 0.144 mm; breadth, 0.038. Common.

SURIRELLA ELEGANS Ehr. var. NORVEGICA (Eulenst.) Brun. fo. OBTUSA A. Mayer. Plate 3, fig. 5.

Surirella elegans Ehr. var. *norvegica* (Eulenst.) Brun. fo. *obtusa* A. MAYER, Bacillar. d. Regensburger Gewässer (1913) 344, pl. 23, fig. 1.

Valve linear-elliptical with rounded and obtuse ends. Length, 0.235 mm; breadth, 0.037. Costæ 2, striæ 40, in 0.01 mm. Common. Known from Europe.

SURIRELLA GRACILIS (W. Smith) Grun. fo. **CURVATA** fo. nov. Plate 3, fig. 19.

Valve linear-elliptical, irregularly curved. Length, 0.045 mm; breadth, 0.006. Costæ 8, striæ 24, in 0.01 mm. Uncommon.

SURIRELLA LINEARIS W. Smith var. **CONSTRICTA** (Ehr.) Grun.

Surirella linearis W. Smith var. *constricta* (Ehr.) Grun., FR. HUSTEDT, Bacillar. (1930) 434, fig. 839.

Valve elliptical, constricted, attenuate at the ends. Length, 0.057 mm; breadth, 0.01. Common. Reported from Aokiko and Kizaki Lakes.

SURIRELLA OVATA Kütz. Plate 4, fig. 17.

Surirella ovata Kütz., FR. HUSTEDT, Bacillar. (1930) 442, fig. 864.

Valve elongate-ovate, broad at one end and attenuate at the other. Length, 0.017 to 0.024 mm; breadth, 0.0068 to 0.0085. Costæ 4 to 8 in 0.01 mm. Common. Known from fresh and brackish water.

SURIRELLA OVATA Kütz. var. **PINNATA** (W. Smith). Plate 3, fig. 16.

Surirella ovata Kütz. var. *pinnata* (W. Smith), FR. HUSTEDT, Bacillar. (1930) 442, fig. 865.

Valve linear-ovate with attenuate ends. Length, 0.035 mm; breadth, 0.0068. Costæ 7, striae 18, in 0.01 mm. Common.

ILLUSTRATIONS

PLATE 1

FIGS. 1 and 2. *Melosira solida* Eulenstein var. *nipponica* var. nov.
3 to 6. *Melosira solida* Eulenstein.
FIG. 7. *Melosira granulata* (Ehr.) Ralfs var. *angustissima* O. Müll.
FIGS. 8 and 9. *Stephanodiscus carconensis* Grun. var. *pusilla* Grun.
FIG. 10. *Melosira solida* Eulenstein.
FIGS. 11 to 13. *Stephanodiscus carconensis* Grun. var. *pusilla* Grun.
FIG. 14. *Stephanodiscus carconensis* Grun. var. *pusilla* Grun.?
15. *Cyclotella glomerata* Bachmann fo. *nipponica* Skv.
16. *Melosira americana* Kütz. fo. *nipponica* fo. nov.
17. *Melosira solida* Eulenstein.
18. *Stephanodiscus carconensis* Grun. var. *pusilla* Grun.
19. *Stephanodiscus carconensis* Grun.
20. *Melosira granulata* (Ehr.) Ralfs? var. *muzzanensis* (Meister) Bethge?
21. *Melosira solida* Eulenstein var. *nipponica* var. nov.
22. *Cyclotella comta* (Ehr.) Kütz. var. *oligactis* (Ehr.) Grun.
23. *Stephanodiscus carconensis* Grun.
24. *Melosira solida* Eulenstein.
25. *Synedra minuscula* Grun. var. *capitata* var. nov.
26. *Coscinodiscus lacustris* Grun. var. *nipponica* var. nov.
FIGS. 27 and 28. *Stephanodiscus biwensis* sp. nov.

PLATE 2

FIG. 1. *Navicula scutelloides* W. Sm.
2. *Navicula radiosa* Kütz. fo. *nipponica* fo. nov.
3. *Achnanthes Clevei* Grun.
4. *Synedra acus* Kütz.
5. *Surirella biwensis* sp. nov.
6. *Pinnularia gibba* Ehr. var. *biwensis* var. nov.
7. *Caloneis nipponica* sp. nov.
8. *Cymbella turgidula* Grun. var. *nipponica* var. nov.
9. *Caloneis bacillum* (Grun.) Meresch. var. *lancettula* (Schulz.) Hust.
10. *Navicula subhamulata* Grun.
11. *Epithemia sorex* Kütz. var. *gracilis* Hust.
12. *Neidium obliquestriatum* A. S.
13. *Gomphonema parvulum* (Kütz.) Grun. var. *exilissima* Grun.
14. *Rhoicosphenia curvata* (Kütz.) Grun.
15. *Eunotia sudetica* (O. Müll.) Hust. var. *nipponica* var. nov.
16. *Synedra Ulna* (Nitzsch) Ehr. var. *oxyrhynchus* (Kütz.) Van Heurck fo. *constricta* Hust.
17. *Gomphonema vastum* Hust. var. *elongata* Skv.

FIG. 18. *Navicula lanceolata* (Agardh) Kütz. var. *nipponica* var. nov.
19. *Gomphonema lingulatum* Hust. var. *pumila* var. nov.
20. *Pinnularia Braunii* (Grun.) Cleve var. *amphicephala* (A. Mayer) Hust. fo. *nipponica* fo. nov.
21. *Synedra parasitica* W. Smith.
22. *Navicula dicephala* (Ehr.) W. Smith. var. *neglecta* (Krasske) Cleve.
23. *Diploneis ovalis* (Hilse) Cleve var. *oblongella* (Naeg.) Cleve fo. *nipponica* fo. nov.
24. *Nitzschia tryblionella* Hantzsch var. *debilis* (Arnott) A. Mayer.

PLATE 3

FIG. 1. *Diploneis ovalis* (Hilse) Cleve var. *bipunctata* var. nov.
2. *Navicula similis* Krasske var. *nipponica* var. nov.
3. *Navicula falaisiensis* Grun. var. *nipponica* Skv.
4. *Gyrosigma Spencerii* (W. Smith) Cleve var. *nodifera* Grun.
5. *Surirella elegans* Ehr. var. *norvegica* (Eulenst.) Grun. fo. *obtusa* A. Mayer.
6. *Cymbella lata* Grun. var. *nipponica* var. nov.
7. *Synedra rumpens* Kütz. var. *fragilarioides* Grun. fo. *nipponica* fo. nov.
8. *Pinnularia nipponica* Skv.
9. *Caloneis nipponica* sp. nov.
10. *Epithemia turgida* (Ehr.) Kütz.
11. *Gomphonema lingulatum* Hust. var. *elongatum* var. nov.
12. *Gomphonema intricatum* Kütz. var. *pumila* Grun.
13. *Gomphonema lingulatum* Hust.
14. *Navicula rostellata* Kütz. var. *biwensis* var. nov.
15. *Neidium dubium* (Ehr.) Cleve fo. *constricta* Hust.
16. *Surirella ovata* Kütz. var. *pinnata* (W. Smith).
17. *Navicula minuta* sp. nov.
18. *Caloneis punctata* sp. nov.
19. *Surirella gracilis* (W. Smith) Grun. fo. *curvata* fo. nov.
20. *Navicula radiosa* Kütz. fo. *nipponica* fo. nov.

PLATE 4

FIG. 1. *Surirella tenera* Greg. var. *nipponica* var. nov.
2. *Navicula undulata* sp. nov.
3. *Diploneis marginestriata* Hust. var. *nipponica* var. nov.
4. *Cymbella turgidula* Grun. var. *nipponica* var. nov.
5. *Surirella nipponica* Skv.
6. *Gomphonema lanceolatum* Ehr. var. *insignis* (Greg.) Cleve.
7. *Navicula menisculus* Schum.
8. *Navicula peregrina* (Ehr.) Kütz. var. *nipponica* var. nov.
9. *Navicula tuscula* (Ehr.) Grun. var. *densistriata* var. nov.
10. *Navicula mutica* Kütz. var. *nipponica* var. nov.
11. *Diploneis ovalis* (Hilse) Cleve var. *nipponica* var. nov.
12. *Pinnularia undulata* Greg. var. *nipponica* var. nov.
13. *Synedra nipponica* Skv.
14. *Frustulia rhomboides* (Ehr.) de Toni var. *saxonica* (Rabh.) de Toni fo. *nipponica* fo. nov.

FIG. 15. *Caloneis nipponica* sp. nov.
16. *Cocconeis disculus* Schum. var. *nipponica* var. nov.
17. *Surirella ovata* Kütz.

PLATE 5

FIG. 1. *Surirella robusta* Ehr. var. *nipponica* var. nov.
2. *Pinnularia gibba* Ehr.
3. *Pinnularia Braunii* (Grun.) Cleve var. *nipponica* var. nov.
4. *Nitzschia acuta* Hantzsch.
5. *Achnanthes Clevei* Grun. var. *nipponica* Skv.
6. *Pinnularia striatula* sp. nov.
7. *Stauroneis Smithii* Grun. var. *rhombica* Meister.
8. *Navicula soodensis* Krasske.
9. *Nitzschia Lorenziana* Grun. var. *subtilis* Grun.
10. *Navicula Kawamuræ* sp. nov.
11. *Navicula subhamulata* Grun. var. *parallela* var. nov.
12. *Navicula costulata* Grun. var. *nipponica* var. nov.
13. *Navicula costulata* Grun. fo. *curta* fo. nov.
14. *Achnanthes Biasolettiana* Kütz.
15. *Attheya Zachariasi* Brun.
16. *Navicula costulata* Grun. var. *tenuirostris* var. nov.
17. *Navicula Nippon* sp. nov.
18. *Achnanthes affinis* Grun.
19. *Diploneis ovalis* (Hilse) Cleve var. *oblongella* (Naegeli) Cleve.
20. *Cymbella nipponica* sp. nov.
21. *Synedra nana* Meister var. *nipponica* Skv.
22. *Gomphonema Berggrenii* Cleve.
23. *Cymbella nipponica* sp. nov.

PLATE 6

FIG. 1. *Coscinodiscus lacustris* Grun. var. *nipponica* var. nov.
2. *Stephanodiscus carconensis* Grun. Anomaly.
3. *Pinnularia polyonca* (Breb.) O. Müll. var. *nipponica* var. nov.
FIGS. 4 and 5. *Eucocconeis onegensis* Wisl. and Kolbe.
FIG. 6. *Frustulia vulgaris* Thwait. var. *asiatica* Skv.
7. *Amphora ovalis* Kütz. var. *libyca* (Ehr.) Cleve.
8. *Pinnularia Lacus Biwa* sp. nov.
9. *Caloneis silicula* Ehr. var. *baicalensis* Skv. and Mayer.
10. *Pinnularia viridis* (Nitzsch) Ehr. var. *leptogongyla* (Ehr.? Grun.) Cleve.
11. *Nitzschia tryblionella* Hantz. var. *victoriæ* Grun.
12. *Achnanthes Hauckiana* Grun. var. *nipponica* var. nov.
13. *Navicula menisculus* Schum.
14. *Synedra Ulna* (Nitzsch) Ehr. var. *Ramesi* (Herib. and Peragallo) Hust.
15. *Navicula Lambda* Cleve var. *nipponica* var. nov.
16. *Gomphonema lingulatum* Hust.

PLATE 7

FIG. 1. *Gyrosigma attenuatum* (Kütz.) Rabh. var. *nipponica* var. nov.
2. *Rhoicosphenia curvata* (Kütz.) Grun. var. *major* Cleve.

FIG. 3. *Pinnularia platycephala* Cleve var. *Hattoriana* Meister fo. *angustior* fo. nov.
4. *Surirella biwensis* sp. nov.
5. *Navicula lanceolata* (Agardh) Kütz. var. *nipponica* var. nov.
6. *Navicula undulata* sp. nov.
7. *Navicula placentula* (Ehr.) Grun.
8. *Navicula achnanthoides* sp. nov.
9. *Navicula hasta* Pant. var. *gracilis* var. nov.
10. *Nitzschia Clausii* Hantzsch.
11. *Caloneis bacillum* (Grun.) Meresch. var. *lancettula* (Schulz.) Hust. fo. *densistriata* fo. nov.
12. *Pinnularia Kawamuræ* sp. nov.

PLATE 8

FIG. 1. *Neidium obliquestriatum* A. S. var. *elongata* var. nov.
2. *Pinnularia undulata* Greg. var. *nipponica* var. nov.
3. *Pinnularia cucumis* sp. nov.
4. *Pinnularia Nakaii* sp. nov.
5. *Pinnularia nipponica* Skv.
6. *Pinnularia major* (Kütz.) Cleve var. *nipponica* var. nov.
7. *Gomphonema vastum* Hust. var. *maxima* var. nov.
8. *Navicula gastrum* Ehr. fo. *nipponica* fo. nov.
9. *Navicula crucicula* (W. Smith) Donk. var. *obtusata* Grun.
10. *Didymosphenia geminata* (Lyngb.) M. Schmidt.
11. *Pinnularia viridis* (Nitzsch) Ehr. var. *fallax* Cleve.
12. *Eunotia gracilis* (Ehr.) Rabh.
13. *Eunotia prærupta* Ehr. var. *bidens* Grun.

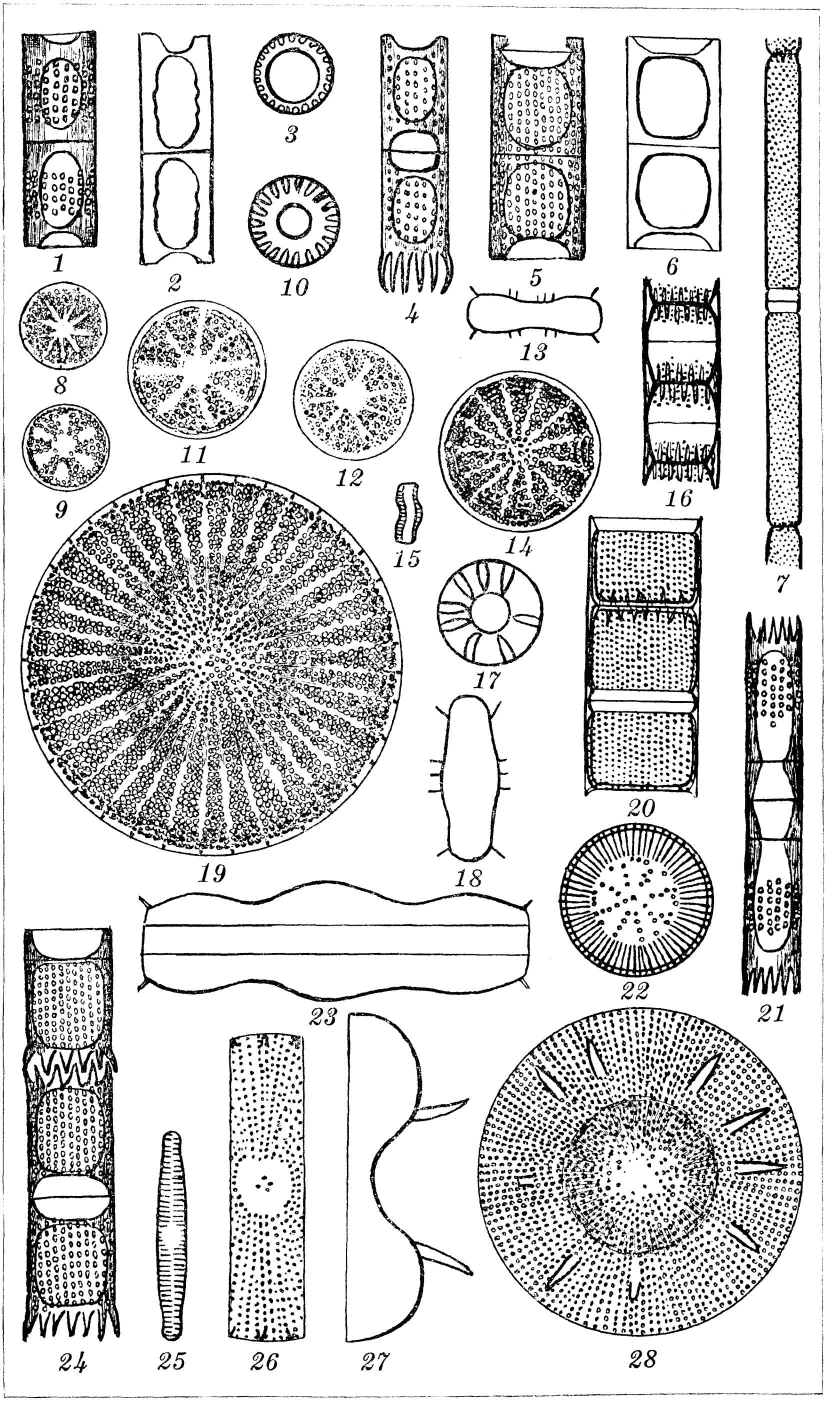


PLATE 1.

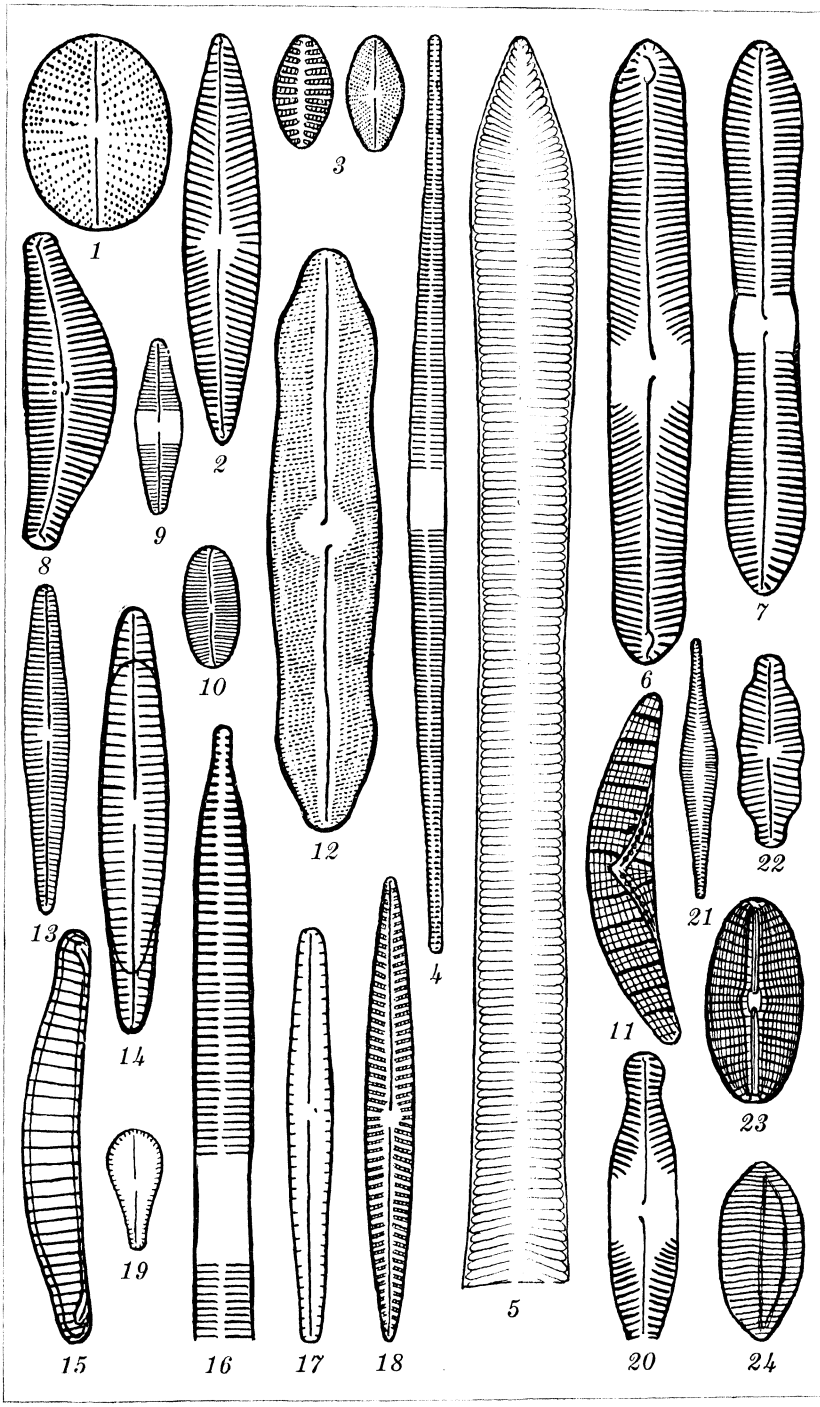


PLATE 2.

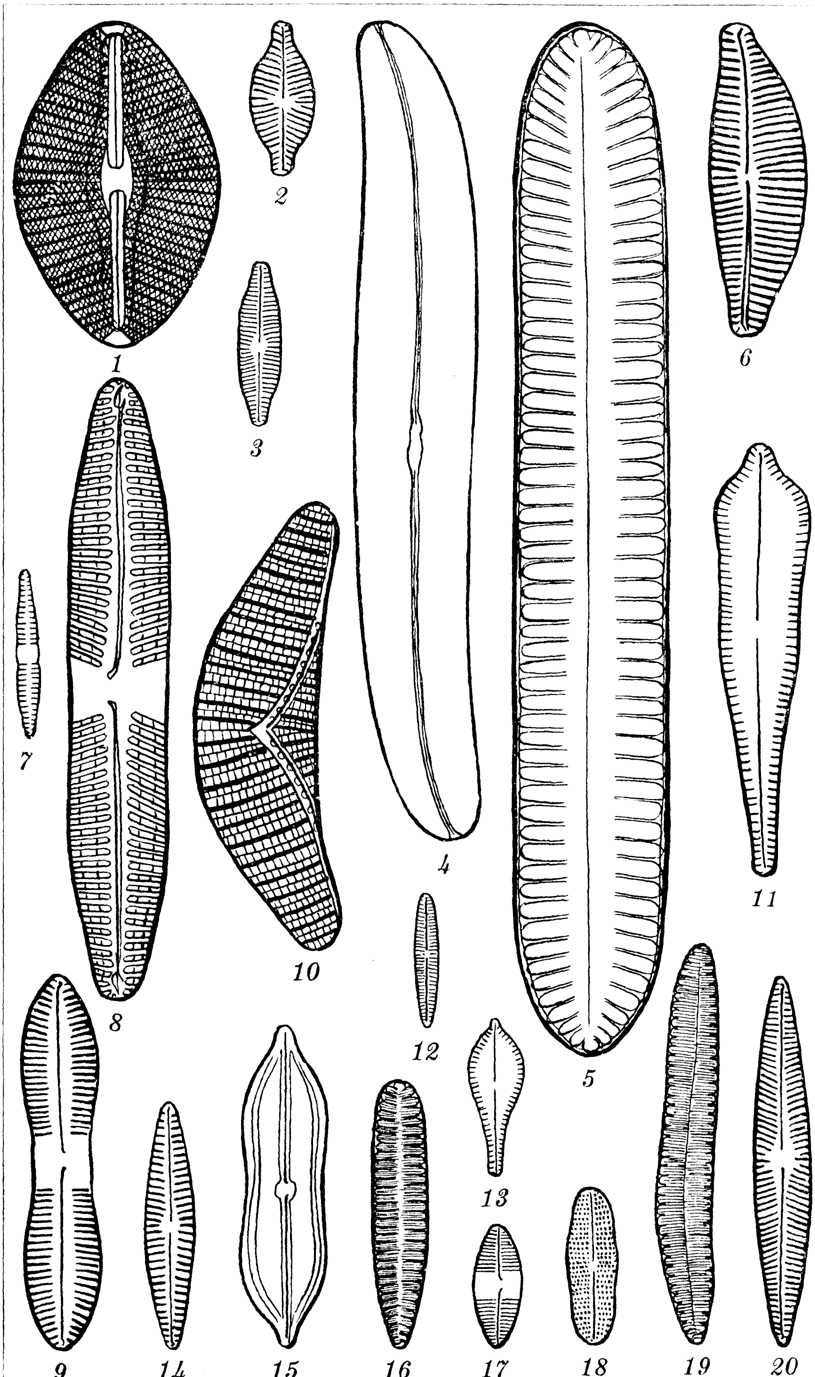


PLATE 3.

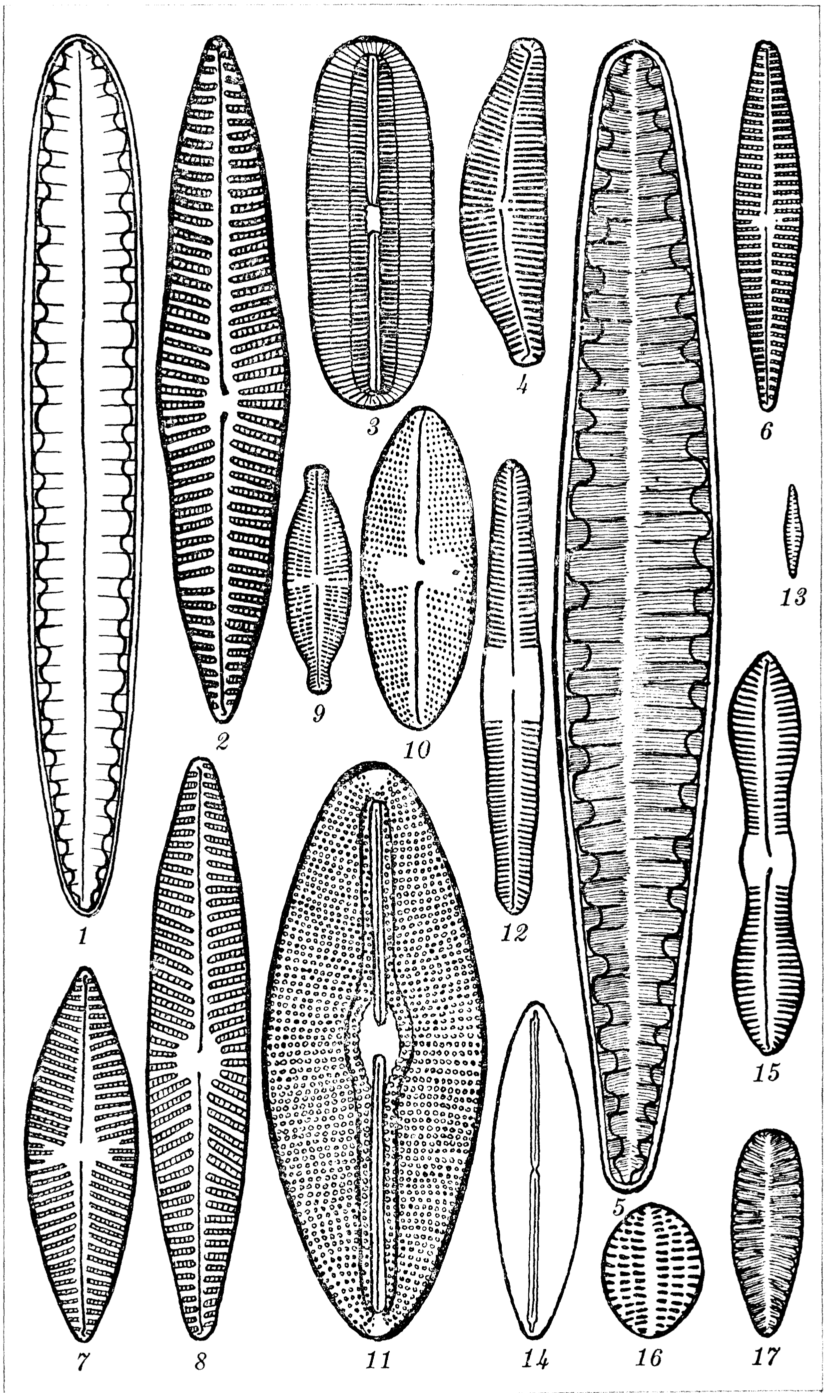


PLATE 4.

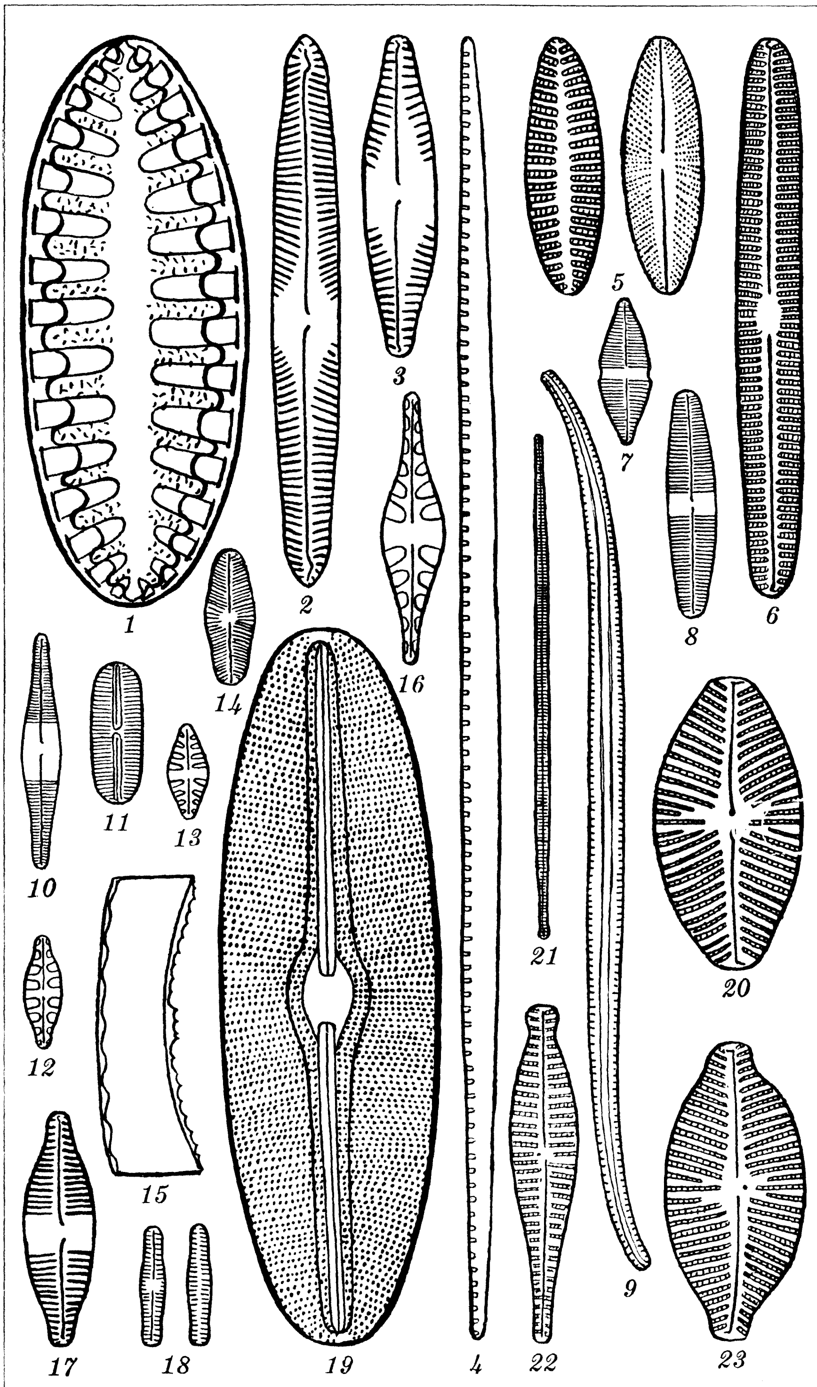


PLATE 5.

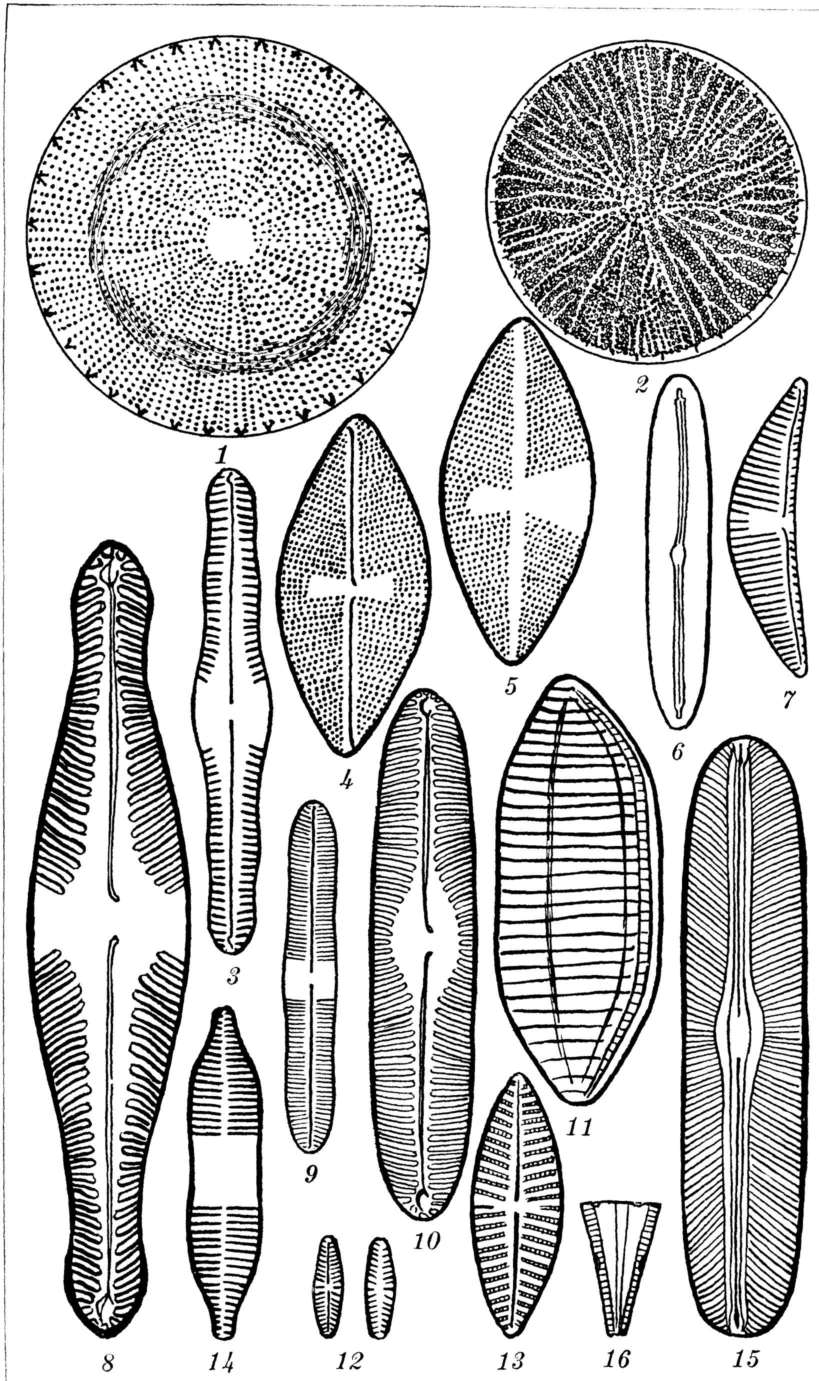


PLATE 6.

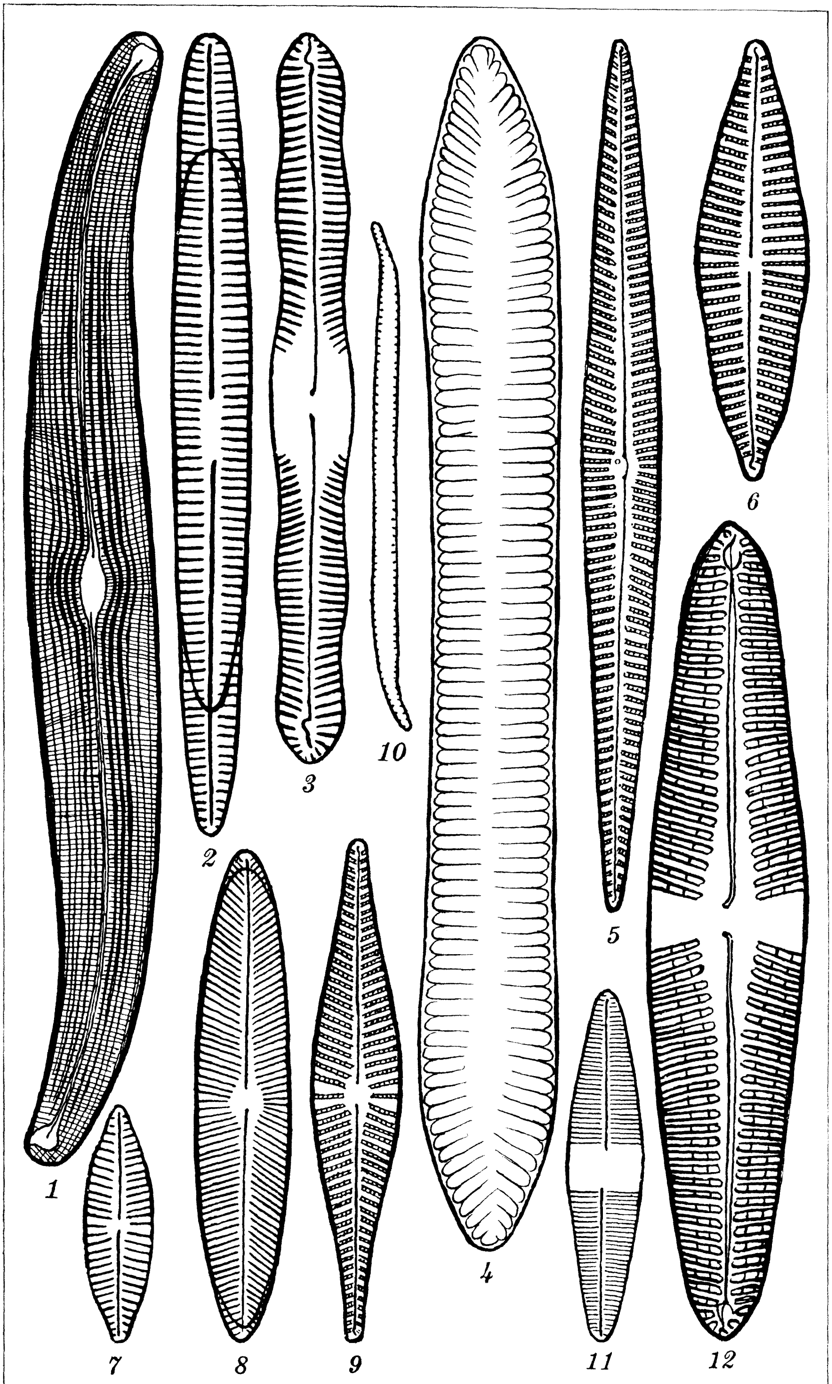


PLATE 7.

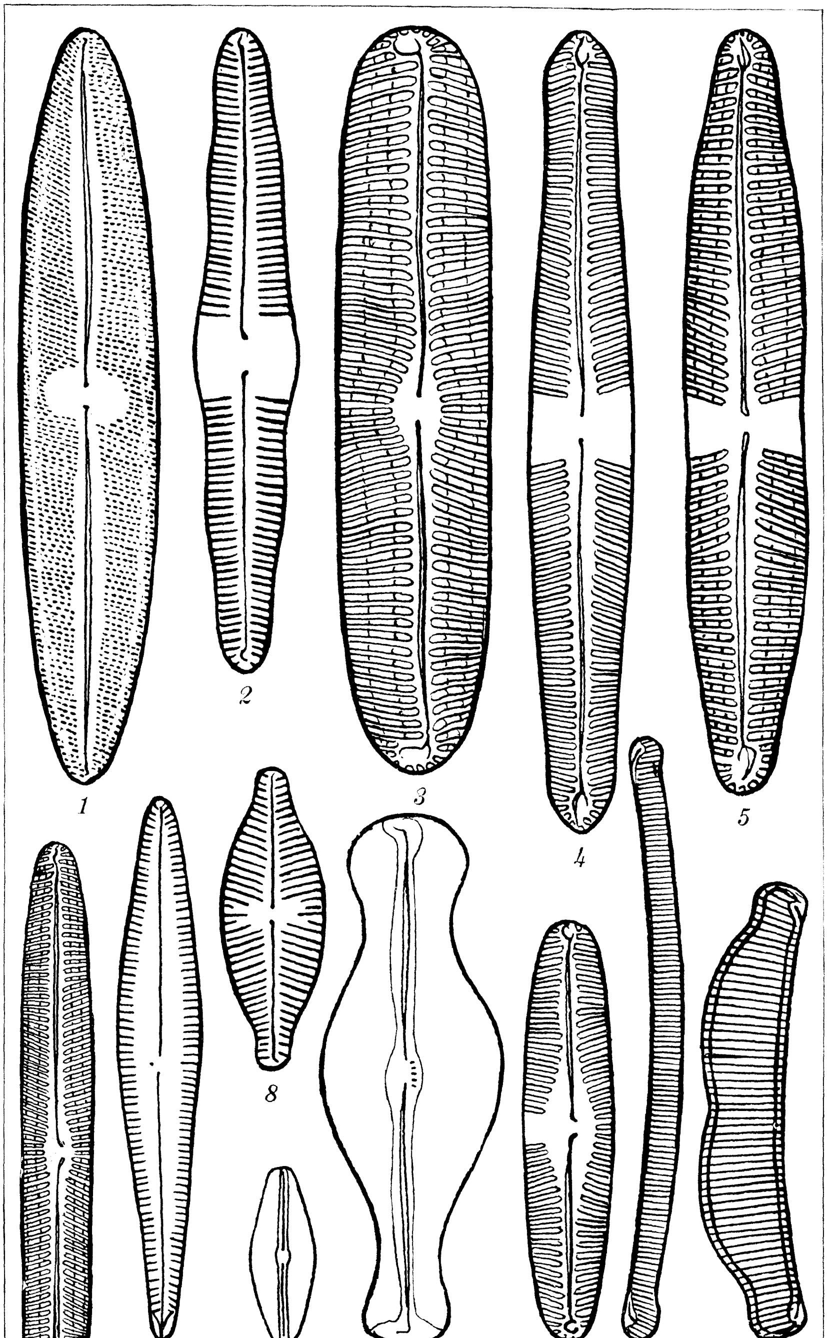


PLATE 8.

BOOKS

Acknowledgment of all books received by the Philippine Journal of Science will be made in this column, from which a selection will be made for review.

RECEIVED

American society for testing materials. Committee D-13 on textile materials. A. S. T. M. standards on textile materials. Philadelphia, Pa., 1935. 246 pp., illus. Price, paper, $1.50.

ANDREWS, ANDREW I. Enamels: the preparation, application, and properties of vitreous enamels. 1st ed. Champaign, Ill., The Twin city printing co., 1935. xviii + 410 pp., illus. Price, $5.50.

BAKER, JOHN R. Cytological technique. London, Methuen & co., 1933. xi + 131 pp., illus.

BROMLEY, DOROTHY DUNBAR. Birth control: its use and misuse. With an introduction by Robert Latou Dickinson. New York and London, Harper & brothers, 1934. xxii + 304 pp. Price, $2.50.

BUEHLER, E. C., comp. and ed. Free medical care: socialized medicine. New York, Noble & Noble, 1935. Price, $2.

DEMPWOLFF, OTTO. Vergleichende lautlehre des austronesischen wortschatzes, I. Berlin, D. Reimer, 1934. (Zeitschrift für eingeborenensprachen. Beihefte 15.) 124 pp. Price, $3.25.

DUGDALE, J. N. Health in hot climates. 2d ed. London, John Bale sons & Danielsson, 1931. 189 pp. Price, $1.25.

GHOSH, DIRENDRA NATH. A treatise on hygiene and public health, with special reference to the tropics. Rev. and largely rewritten with the assistance of A. D. Stewart. 8th ed. Calcutta, Scientific publishing co., 1935. xv + 660 pp., illus. Price, $3.25.

GRAUBARD, MARK. Genetics and the social order. New York city, Tomorrow publishers, 1935. 127 pp., 14 diagrs. Price, paper, $0.50; cloth, $0.75.

HEISE, FRED H., ed. 1000 questions and answers on T. B. New York, Journal of the outdoor life, 1935. vi + 232 pp. Price, $0.75.

HOTTES, ALFRED CARL. 1001 Garden questions answered. New York, A. T. De La Mare company, 1935. ix + 320 pp., illus. Price, $2.

HOWARD, LOUISE E. Labour in agriculture: an international survey. London, Oxford university press, 1935. xiv + 339 pp. Price, $7.

ILLICK, JOSEPH S. An outline of general forestry. N. Y., Barnes & Noble [c. 1935]. 259 pp., illus. Price, $1.50.

JOHNSTONE, JAMES. The marine plankton; with special reference to investigations made at Port Erin, Isle of Man, during 1907-1914. A handbook for students and amateur workers, by James Johnstone, and

Andrew Scott and Herbert C. Chadwick, with an introduction by Sir William A. Herdman. Third reprint. London, The University press of Liverpool [etc.] 1934. xvi + 194 pp., illus. Price, $3.25.

KILPATRICK, WILLIAM. Sugar factories and sugar machinery. London, The Institution of mechanical engineers, 1933. 70 pp., illus.

LANGEN, C. D. DE, and A. LICHTENSTEIN. A clinical textbook of tropical medicine. 1st Eng. ed. from the rev. 3d Dutch ed. Batavia (etc.), G. Kolff & co., 1936. xi + 537 pp., xiii–xxxv., illus.

LUTHRINGER, GEORGE F. The gold-exchange standard in the Philippines. Princeton, Princeton university press, 1934. xvi + 291 pp., tables, diagrs. Price, $3.

MCGUIRE, CHRISTIE. Ulcers in the tea-gardens. Calcutta, The Catholic orphan press, 1934. Cover title, 16 pp., plates.

MARSHALL, C. E. Colloids in agriculture. London, Edward Arnold & co., 1935. vii + 184 pp., illus. Price 5/-.

MERRILL, ELMER DREW. An enumeration of plants collected in Sumatra by W. N. and C. M. Bangham, by Elmer Drew Merrill. Jamaica Plain, Mass., The Arnold arboretum of Harvard university, 1934. 178 pp., illus. Price, $2.50.

NEELY, WAYNE CALDWELL. The Agricultural fair. New York, Columbia university press., 1935. xii + 313 pp., illus. Price, $3.75.

PEYRE, EDOUARD. Manuel de sérologie pratique. Paris, Librairie Felix Alcan, 1935. xxiii + 267 pp., tables. Price, $1.

RICHMOND, WINIFRED V. An introduction to sex education. New York, Farrar & Rinehart [c. 1934]. xiv + 312 pp., illus. Price, $2.50.

ROHRER, CALEB WYAND GEETING. Researches in cancer: part one, 1896–1921; 1922–1932. Baltimore, The Brentwood printing company, 1934. 144 pp., illus. Price, $3.50.

SEDGWICK, WILLIAM THOMPSON. Sedgwick's principles of sanitary science and public health, rewritten and enl. by Samuel C. Prescott and Murray P. Horwood. New York, The Macmillan company, 1935. xviii + 654 pp., tables. Price, $4.25.

SIEGEL, MORRIS. Constructive eugenics and rational marriage. Toronto, McClelland & Stewart [c. 1934]. xiii + 196 pp., illus.

SMALL, VICTOR R. I knew 3000 lunatics. New York, Farrar & Rinehart [c. 1935] vii + 273 pp. Price, $2.50.

SMITH, JAMES GERALD. Economic planning and the tariff; an essay on social philosophy. Princeton, Princeton university press, 1934. x + 331 pp. Price, $3.

SPICER, E. H. The endotoxic infections and their control with edwenil. 5th ed. rev. Watford, Herts., E. H. Spicer & co., 1935. 141 pp.

TILDEN, JOSEPHINE E. The algæ and their life relations; fundamentals of phycology. Minneapolis, Minn., University of Minnesota press, 1935. xii + 550 pp., illus. Price, $5.

Union of Soviet Socialist Republics. State planning commission of the council of peoples commissars. Summary of the fulfillment of the first five-year plan for the development of the national economy of the U. S. S. R. Report. 2d rev. ed. New York, International publishers, 1933. 304 pp. Price, $1.25.

REVIEWS

Garden Flowers in Color; a Picture Cyclopedia of Flowers. By Glendon A. Stevens. The Macmillan Company, New York, 1934. 320 pp., col. illus. Price, $3.75.

This is a unique book on ornamentals. The author acknowledges that it has been written for the most part from actual garden acquaintance with the wide range of flowers described in it. He claims that in so doing his purpose is to provide "a book of definite educational value as well as a convenient garden adjunct." To see how far in each case the book meets his expectations, one needs only to glance at the assembly of over 300 garden flowers illustrated with much fidelity in their natural colors with beautiful photographic plates. These illustrations, which are enough to make one welcome the book, will show many an inexperienced gardener just what most garden blooms look like. Each illustration is accompanied by a brief account of the habits of the plants, their use, and cultivation. This is an added feature which makes the book doubly useful as a dependable guide to garden flowers. The descriptions are brief and include the scientific names of the flowers.

The arrangement is alphabetical, but individual plants are better located by consulting the index.—E. Q.

Economic Geography of Asia. By Daniel R. Bergsmark. Prentice-Hall, Inc., New York, 1935. 618 pp., illus., diagrs., maps. Price, $5.

While a few good books on Asia have already been published, Bergsmark's technic meets ideally the average requirements of a college textbook on Asia. His is always on the alert, evaluating the mutual relationships which may be established between man's manifold activities in his effort to earn his living and the natural environmental complex, thus eliminating unessentials and irrelevant subject matter.

The illustrations, graphs, diagrams, and maps are illuminating, but there are many typographical errors, a few of which are the following: Page 24, Rea Sea; page 72, 9th and 10th lines, of of; page 114, antonomous states; page 210, last line of 3rd paragraph, the the; page 424, coking goal; page 427, potassium iodine.

There are some statements which need to be corrected or improved, such as that on page 27, "In the Philippines, thousands of miles of terraces extend throughout various parts of the ar-

chipelago." Such terraces are only found in the Mountain Province, Luzon, and not throughout the various parts of the Archipelago. On page 69, "While Asia adds but little to the total amounts of coal and iron ore of the commercial world, it does contribute large percentages of the world's tin, antimony, tungsten, graphite and emory." Why not list also copper and gold? Japan is one of the ranking copper producers and so are Manchukuo, Chosen, Taiwan, China, and the Philippines for gold.

The inclusion of Cultural, Religious, and Linguistic Diversity on page 179 under chapter XI, the Natural Environment of India, may lead an unwary student to an erroneous concept of natural environment.

On page 347, "Rice . . .; and the highest yields per acre are obtained in the Candaba Swamp . . ." The Candaba Swamp proper does not produce rice; it is a reserved area for wild life such as birds and fishes. The immediate surrounding land which may have been reclaimed from the original swampy area certainly is not the highest yielder of rice per unit area, but Nueva Ecija, a province in Central Luzon.

Notwithstanding these minor observations, the reviewer considers Bergsmark's Economic Geography of Asia as interestingly readable to the layman; well-suited to college students pursuing a course on Asia; and thought-provoking to teachers, well worth the price of the book.—C. C. C.

Marine Boring Animals Injurious to Submerged Structures. By W. T. Calman. Second edition rev. by G. I. Crawford. British Museum (Natural History) Economic Series No. 10. The British Museum, London, 1936. 38 pp., illus. Price, $0.25.

This pamphlet is a valuable contribution on the subject of marine boring animals and the destructive effect they may have on submerged structures. It sums up our present-day knowledge of the natural history of the animals concerned and offers significant details which are useful both to zoölogists and to marine engineers who are interested in the practical application of the facts recorded.

The pamphlet is well illustrated. A list of the most important titles is given to provide guidance for those who wish to pursue the subject further.—F. T.

Wistar Institute Style Brief. Prepared by the coöperative efforts of the editors of journals published by the Wistar Institute and the staff of the Wistar Institute Press. The Wistar Institute Press, Philadelphia, 1934. 169 pp., illus., plates. Price, $2.

This handbook is a concise answer to the long-felt need for a style guide especially designed to meet the problems of the technical and scientific writer. Principles that scientific writers and editors have so far had to evolve laboriously for themselves from experience and continual groping after what is common sense, are here laid down in simple and direct form, so as to be available to the consultant at a moment's notice.

While the purpose of this little book is largely to explain Wistar Institute methods to biological writers, and to promote coöperation between author and editor, it cannot fail to be extremely welcomed to those interested in the writing and publication of scientific and technical papers in general, as the suggestions it contains, except as pertaining to matters of practice with regard to which even the best printing offices are at variance, apply to technical writing in any field.

Writers of scientific papers who hitherto felt that there is a definite technic to be acquired about the preparation of papers for publication, have had to rely on books of such general scope as the Style Manual of the United States Printing Office, and other first rate desk books that do have great practical utility and go into some detail in specialized fields, but are inadequate as sole reference books on the many crotchety problems confronting the technical writer. The Wistar Institute style book, though not as detailed, offsets these shortcomings of the general desk book, and can be used with equal profit either as a supplementary reference guide or independently.

One gratefully notices that, as far as scientific papers are concerned, the authors have regarded no problem as too trivial or too complex to come within the scope of the book. Choice of paper, margins, and pagination are given as definite treatment as reference lists and the most suitable method of preparing illustrations under different technical and financial conditions.

Intelligent use of this style brief will save the author considerable misdirected effort; even the seasoned author will find

it a profitable means of clarifying and confirming rules that he has built up in the course of time out of his own experience. The new author will find the brief, direct discussion of what constitutes a well-prepared technical paper invaluable.—S. R.

Electrons (+ and −), Protons, Photons, Neutrons, and Cosmic Rays. By Robert A. Millikan. (The University of Chicago Science Series.) The University of Chicago Press, Chicago, Illinois, 1935. 492 pp., illus. Price, $3.50.

This volume is the answer to the scientist's prayer for a clearer conception of modern physics, in which the author, whose works are widely used not only in America but also in other countries, presents some of the newer developments in the field with which he has closely associated his own work. These are the recent researches on the wave nature of the electron, the spinning electron, the positron, the neutron, transmutation of the elements and cosmic rays. Although by weaving the discussion around these subjects the author makes the book interesting, the general reader will find certain chapters the understanding of which requires more than a background of physics. Except for this requirement, any reader with scanty technical training may still get a lot of valuable information on the fascinating progress of modern physics described in this book. —J. C. E.

Reproduction, Heredity and the Development of Sex. By H. G. Wells, Julian Huxley [and] G. P. Wells. Cassell & Company, Ltd., London, etc., 1935. 222 pp., 40 figs. Price, $1.

This small volume is the fourth in "The Science of Life" series, somewhat enlarged and brought up to date. Beginning with a discussion of the primitive types of reproduction which may be considered a special type of growth accompanied by detachment of daughter organisms, the authors arrive at the conclusion that sex is not reproductive. Sex is essentially antireproductive, inasmuch as the daughter organisms are not, so to say, chips of the old block, but the result of the interaction of the germinal substances carried by the sex cells from the two parents, who contribute equal amounts of the hereditary material. In this fact lies the means by which variations are reshuffled and recombined among the members of the species. How these variations are transmitted to the offspring is considered in a chapter in which the high lights of genetic knowledge are discussed. An attempt is also made to correlate genetics with embryology, but the result is vague due mainly to the

paucity of data along this line. Finally the authors give a summary of the chromosome theory of sex determination. No bibliography is included, but a good index is given.—A. R.

Practical Infra-Red Photography. By Othmar Helwich. A translation by J. L. Baring from the German of "Die Infrarot-Fotografie." The Fountain Press, 19 Cursitor Street, E. C. 4, London. [No date] illus. Price, $1.

Infra-red photography is a phase of photographic technic that has been developed within the last few years. In this book Othmar Helwich outlines its essential principles and describes its possible applications in various fields.

Nowhere is the infra-red plate more useful than in scientific photography, and the author bares its special adaptability in medicine, astronomy, criminology, and photomicrography. That it is also useful in photographing old documents, reproducing faded manuscripts, and testing fabrics is likewise shown by him.

Insofar as it instructs the amateur as well as the professional photographer and the scientist regarding the nature of infrared photography, this book is valuable.—C. S. A.

Oxygen and Carbon Dioxide Therapy. By Argyll Campbell and E. P. Poulton. Foreword by Sir Leonard Hill. Oxford University Press: Humphrey Milford, London, 1934. 179 pp., illus. Price, 12s. 6d.

The mass of information scattered in scientific literature and the results of the extensive research and clinical observations of the authors are combined to form the basis of the present book.

Oxygen therapy has now become the established treatment for pneumonia and other pulmonary conditions, certain cases of cardiac failure, and carbon monoxide poisoning. For efficient treatment of these conditions a suitable apparatus is necessary. In this book the authors describe fully the different methods of giving oxygen treatment efficiently. A breathing mask or an intranasal tube must be used, or the patient be put in an oxygen chamber or oxygen tent. For this purpose the use of such apparatus as Bragg's and Drinker's for giving continuous respiration is described.

The treatise is divided into nine chapters, at the end of which is a summary for the sake of readers who may not have the time to weigh the whole of the evidence. It is also supplied with an adequate bibliography.

To practitioners and hospital directors, especially in the Philippines where the old clinical method of administration is still in vogue, in order to give them an insight of the modern methods of oxygen administration, this book is recommended.—I. C.

Human Sterilization To-day; a Survey of the Present Position. By Cora B. S. Hodson. Watts & Co., London, 1934. 55 pp. Price, $0.50.

One drawback to the book is the small print, which makes it difficult to read. However, it is an interesting collation of the scientific and experimental work on sterilization hitherto done in America and Europe. It presents beneficial results which should be wisely considered by all economists, eugenists, and political and social workers, as well as by officials of penal and psychopathic institutions. The application of sterilization in the Philippines as a means of improving the race and as a preventive measure in limiting hereditary, mental, and physical disabilities should be food for serious thought among progressive thinking Filipinos.—U. D. M.

Applied Silviculture in the United States. By R. H. Westveld. Edward Bros., Inc., Ann Arbor, Michigan, 1935. 416 pp., illus.

This publication on regional silviculture in the United States brings together the results of various studies made by the author, the Forest Service, experiment stations, and forest schools. Eighteen forest regions, eight in the western, nine in the eastern part of the United States, and one in Alaska, are thoroughly discussed under the main headings of Description, Historical, Ecological Basis for Silvicultural Practice, Economic Basis for Silviculture Practice, and the Application of Silviculture. Each chapter has been submitted for review to one or more authorities in the region to which the chapter applies so that the book may be considered authoritative. The book gives the reader a good idea of the physical and economic limitations, the present condition, and the modifications or improvements that must be developed in each of the forest regions.

The book is lithoprinted in two-column style and is well illustrated with photographs. There is a list of references at the end of each chapter and an index to the whole book. An appendix gives the common and scientific names of trees.—C. S.

Sex Behavior in Marriage. By Charles A. Clinton. Pioneer Publication, Inc., 1270 Sixth Ave., Radio City, N. Y., 1935. 159 pp., illus. Price, $2.

This book is excellent for the layman, but rather elementary for the physician. The anatomy and physiology of sex are explained in simple terms. The facts of life are explained to prospective newlyweds in a way to avoid shocking the sensitive. The facts dealing with the psychology of coitus and its proper performance may train prospective mates to avoid various pit-

falls that otherwise might cause marital unhappiness. It will enable parents to safeguard their children from half-truths gleaned furtively from unreliable sources.—B. M.

Race Differences. By Otto Klinberg. Harper & Brothers, Publishers, New York and London, 1935. 367 pp. Price, $2.50.

This book discusses race differences from three distinct approaches; namely, biological, psychological, and cultural. The author states that there is no racial hierarchy that is consistently supported by all the available evidence, and that the notion that one race is more primitive than another has no acceptable scientific foundation. He also states that he has carefully evaluated the theories on psychological race differences and has found them to have no basis in the study of physical characteristics, endocrine glands, blood, or brain; or in tests of sensory capacity, intelligence, or personality; or in the analysis of criminal statistics. He has further analyzed the relation between culture and psychology and has shown that fundamental behavior differences in race groups can be explained on a cultural basis. He concludes "that there is no adequate proof of fundamental race differences in mentality, and that those differences which are found are in all probability due to culture and the social environment." The book contains exhaustive material with clear and lucid exposition of facts intended primarily for students and the intelligent layman. Every student interested in ethnology should have a copy of this book.—R. E. G.

The Technique of Contraception; an Outline. By E. M. Mastner. Published for the National Medical Council on Birth Control, by the Williams & Wilkins Co., Baltimore, 1936. 40 pp., illus. Price, $0.50.

This is a short, concise, and to-the-point manual of practical instruction on the safest and most effective methods of contraception known at present.

In a foreword by Robert L. Dickson, the point is brought out, one that is too often overlooked, that from a standpoint of safeguarding the health of mothers, the whole question of contraception is of public-health significance and properly belongs to the department of preventive medicine.

In the discussion of the technic of contraception the author makes the usual divisions into general measures applicable to the male, measures used by the female, and measures giving prolonged protection such as intra-uterine stems, hormones, spermotoxins.

Though it is written primarily for the medical profession, there is nothing in the outline that would not be readily understood by an intelligent layman.

Despite its brevity, the book is profusedly illustrated by diagrams, showing the precise manner in which vaginal diaphragms and cervical caps should be used. The book is very practical and worth reading by any student interested in the subject.—U. D. M.

THE PHILIPPINE JOURNAL OF SCIENCE

VOL. 61 NOVEMBER, 1936 NO. 3

PHILIPPINE CICADELLIDÆ (HOMOPTERA)

By GONZALO MERINO

Of the Bureau of Plant Industry, Manila

FOUR PLATES

INTRODUCTION

The Nearctic and Palæarctic species of the family Cicadellidæ, which includes many pests of crops, have been well worked. However, the Oriental species, especially those of the Malayan region, have been very little studied. Distant [1] thinks the Cicadellidæ, being practically unworked in certain sections of the world, may prove to be the most extensive family of the Homoptera.

The description of Philippine species started with miscellaneous collections by early collectors. Most of the specimens described were from the British Museum. Among the early workers were Walker, Stål, and Signoret. Later Melichar, Kirkaldy, Matsumura, Distant, and Baker became prominent as describers of eastern Palæarctic, Oriental, and Australian, as well as Indian, Cicadellidæ. Baker collected and described more Philippine species of this family than all of the other above-mentioned workers together. All of Baker's work on Philippine Cicadellidæ was published in the Philippines. His collection in the United States National Museum is practically untouched.

The nucleus of the present work on Philippine Cicadellidæ was the few specimens that I took from the Islands, and material subsequently sent to me, from time to time, by my associates

[1] Fauna Brit. Ind. Rhynch. 3 (1906) 52–54.

in the Bureau of Plant Industry. The collection of Professor Osborn contributed several new species and many interesting old forms. Later my studies were extended to the United States National Museum, primarily for the purpose of comparing my types and determinations with the extensive Baker collection from the Philippine Islands. Several additional forms were studied and are described in this paper.

In general I have followed Distant [2] in the arrangement of these insects. It has been necessary, of course, to include some genera subsequently erected by Baker, Kirkaldy, Matsumura, and others, under divisional groupings according to Distant's synopsis. For structural characteristics and descriptions with reference to the names of sclerites and the wing venation of species, the excellent plates of Edwards [3] and Osborn [4] were consulted and adopted.

In this work I have described or determined eighty-three species, thirty-four of which are new; thirty-nine are old species of known Philippine distribution, and fourteen are species reported for the first time from the Philippines. In checking Baker's material and comparing it with the original descriptions, nine more species were listed for the Philippines for the first time. With the descriptions of the species I have recorded the distribution, the host plant, and the economic status where such information was available. *Agellus* DeLong and Davidson, with a known Australian and Nearctic distribution, is here recorded for the first time in the Orient. Four species are described. *Macropsis* was believed to be exclusively Nearctic, Palæarctic, and Ethiopian in distribution, but nine species of this genus came to light in the Philippine material and are herewith described. *Cicadula* is here first recorded as a Philippine genus.

Two genera are erected, one to receive two species, and the other, three. One genus is given a new name. This preoccupied and monotypic genus of Distant,[5] *Aliturus* (now *Alituralis*), receives another species in this paper.

ACKNOWLEDGMENT

The present study of Philippine Cicadellidæ was made possible by the encouragement and unfailing assistance of Prof. Herbert Osborn, of Ohio State University, under whose direction this

[2] Op. cit. 4 (1908).
[3] Hemiptera-Homoptera of the British Isles. L. Reeves & Co. (1896).
[4] Ohio Biol. Surv. 3 No. 4 (1928).
[5] Fauna Brit. Ind. Rhynch. 4 (1908) 398, No. 2667.

work was undertaken. He placed at my disposal his collection of Philippine cicadellids and his private library, which contains a wealth of invaluable literature on this group of insects.

My thanks are also due to Mr. P. W. Oman, taxonomist of the order Homoptera in the United States National Museum, for valuable suggestions and help at the museum, and for the loan of some specimens from the Baker collections; to Dr. H. L. Morrison, in charge of the insect division of the United States National Museum (now of the Bureau of Entomology and Plant Quarantine), for furnishing me with working space and equipment; to Dr. D. M. DeLong for aid, especially in the genus *Agellus;* to Dr. E. P. Breakey, of the department of zoölogy and entomology, Ohio State University, for valuable suggestions and criticism during the early part of this work, the reading of the manuscript, and the checking of some of the specimens, especially those of the genus *Macropsis;* to my colleague in the Bureau of Plant Industry, Mr. F. Q. Otanes, of Manila, who from time to time sent me specimens collected in various parts of the Islands by the inspectors of the Philippine Bureau of Plant Industry; and above all to Dr. Manuel L. Roxas, who did everything possible to enable me to complete my work.

During the preparation of this paper I was guided by the excellent publications of W. L. Distant, C. F. Baker, and H. Osborn. I have occasionally referred to the works of F. Edwards, D. M. DeLong, and E. P. Van Duzee.

Most of the drawings were made by Mrs. C. W. Taft, some by Mr. F. B. Whittington under my supervision, and the rest were drawn by myself.

In the preparation of the check list with the original bibliography and synonymy, I am indebted to Baker's unpublished notes for the names of some species and their synonyms.

ECONOMIC IMPORTANCE OF THE CICADELLIDÆ

The Homoptera are of great concern to man. Among them are insects causing extensive injury to plant life. They are mostly of small size, multiply rapidly, and adapt themselves readily to all climatic conditions. Their attack goes unnoticed until the plants have lost so much vitality that they are either stunted or killed. The Cicadellidæ, therefore, are probably the most important family in this group of insects.

Their astounding breeding capacity, their mode of attack, which is to keep themselves always under the leaves of the host plants, together with their small size and protective coloring,

result in large numbers of them not being noticed until the plants attacked are ready to die.

Usually, however, these attacks do not cause the death of the host plants, but only greatly reduced vitality and productivity. For this reason their presence often escapes notice.

Serrano and Palo[6] estimated the loss of mango fruit due to the persistent attack of the mango leaf hoppers *Idiocerus clypealis* and *Chunra niveosparsa* for 1932 in three mango-growing provinces of Luzon to be 75.32 per cent of the crop.

These small insects occur in great numbers and feed especially on the sap of the young growing shoots. When the hoppers are numerous the amount of sap extracted by them is sufficient to prevent growth and to cause the loss of the entire crop of fruits. Lefroy[7] found that *Nephotettix apicalis* and *N. bipunctatus* multiply enormously and are a distinct plague to rice in India. *Cicadella spectra* Distant is another of the cicadellids that is numerous and ranks as a major pest of rice in India. These three species also occur in abundance in the Philippines and are certainly as bad rice pests here as in India.

Impoasca flavescens, the well-known green fly of tea, whose distribution is world-wide, is a serious pest in India. This species damages cotton and various solanaceous crops in the Philippines.

LIFE HISTORY

Life-history work in this family is practically untouched. It is a field of considerable interest, as these insects have well-defined habitats and plant hosts and seem to be readily affected by such ecologic factors as temperature, moisture, and natural enemies.

Aside from work on the mango leaf hoppers *Idiocerus clypealis* Lethierry and *Chunra niveosparsa* Lethierry, for whose damaged Serrano and Palo[8] proposed the name "blossom-blight of the mango" to distinguish them from the less abundant leaf hoppers found on mango, no life history has ever been attempted on Homoptera in the Philippines.

The cicadellids have multifarious habits. Some are arboreal, some live and breed on herbs and bushes, some on reeds, and many of them feed and breed on old or green pasture grass. Some are solitary, others swarm in great numbers. It is

[6] Philip. Journ. Sci. **50** (1933) 211–277.

[7] Indian Insect Life. Thacker, Spink & Co., London (1909) 738.

[8] Philip. Journ. Sci. **50** (1933) 211–277.

supposed that most of them breed the year round with more or less predominance in certain favorable seasons. Certain species multiply during the dry season, and others appear in great numbers during the rainy season.

The preponderance of a species, however, depends more or less on the abundance of its hosts, and the stage of the host which is succulent to the species concerned. The grass types multiply in great numbers during the rainy season when grasses are growing most vigorously. In the Philippines *Nephotettix apicalis* and *N. bipunctatus* are numerous in the early part of the rainy season, during June, when rice is beginning to grow vigorously. *Idiocerus clypealis* and *Chunra niveosparsa* are abundant on forced mangoes in November and December and on mango blossoms during the regular season; that is, from January to April.

GEOGRAPHIC DISTRIBUTION

The cicadellids have well-defined habitats and plant hosts. Their distribution is limited by climatic conditions and the distribution of their host plants.

In the Tropics plant distribution seems to limit the distribution of the species. The mango pests of India are of the same subfamily as those that attack mangoes in the Philippines, the Idiocerinæ. Whether or not the species of *Idiocerus* on the mango in India are distinct from those in the Philippines is questioned. Sugar canes and bananas have specific leaf-hopper pests that are more or less widely distributed. Some of the species attacking rice are as widely distributed as the area where rice is the commonest crop. *Nephotettix apicalis* Motchoulsky is present from India to Japan, including, of course, the countries and islands intervening.

The distribution of cicadellids is limited by land barriers, high mountains, large bodies of water, and climatic conditions. Each faunal region, unless affected by certain agencies of dissemination, has its own faunal characteristics. The Philippine cicadellids are distinctly Indo-Malayan, tinged with certain Palæarctic elements, which were introduced by commerce. It is possible that some Neotropical species are present due to the early importation of plants from Mexico. However, such introductions are doubtful in view of the distance, the slow transportation at the time, and the bringing of seeds mostly instead of living plants. Some leafhoppers from China and Japan may have gained a foothold through constant importations of or-

namental plants. Perhaps some are due to a land bridge, which may have existed between continental Asia and some part of the Philippines, or a similar connection between Indo-Malayan regions and Palawan and adjacent islands. Some Australian species have been recorded in the Philippines.

Although the species of *Makilingia* are distinctly Philippine, the Idiocerini are most likely of Indian origin. It is difficult to determine the origin of most of these species unless we know their habits and their host plants, as well as the native homes of such hosts. We know that most of the existing species of wide distribution are arboreal. The Tartessusaria, Idiocerini, and most of the well-known Typhlocybinæ and Cicadellinæ are arboreal insects, possibly transported by commerce.

SYSTEMATIC RELATIONS OF THE HOMOPTERA AND DIVERSITY OF OPINION CONCERNING THEM

In the classification of Homoptera first consideration was given to the number of the tarsal and antennal joints, and the character of the wings. Thus Westwood, according to Distant,[9] divided the Homoptera as follows:

Trimera. Tarsi 3-jointed and antennæ minute; wings areolate.
Dimera. Tarsi 2-jointed and antennæ moderate, 6- to 10-jointed; wings areolate.
Monomera. Tarsi 1-jointed, antennæ 6- to 25-jointed; wings not areolate.

Monomera is represented by one family, the Coccidæ; Dimera includes the Psyllidæ, the Aleurodidæ, and the Aphididæ; and Trimera includes the Auchenorrhyncha, on the phylogenetic position of which the authorities disagree.

It is admitted by all that among the trimerous insects the Cicadidæ are the lowest and most generalized, due to the presence of the three ocelli, the venation of the wings, and the poor development of the nervous system.

Here the question arises whether the Membracidæ should follow the Cicadidæ or the Fulgoridæ. It is the opinion of some writers that the Cicadellidæ, because their morphological characteristics and mode of development, occupy the highest rank among the Auchenorrhyncha. Funkhauser,[10] however, suggests that the membracids should be placed between the Cicadidæ and the Cicadellidæ, because the treehoppers have strong affinities with the leafhoppers, and probably came from the same

[9] Fauna Brit. Ind. Rhynch. 3 (1906) 52.
[10] Conn. Geol. & Nat. Hist. Surv. Bull. 34 (1923).

stem as the Cicadellidæ. Lawson,[11] in having the Cicadellidæ follow the Membracidæ, bases his opinion on the New World insect known as *Aethalion,* which looks very much like the Cicadellidæ and has certain characteristics that led Stål and Van Duzee to place it with the Membracidæ and Ashmead to place it under the Bythoscopidæ. Again he bases his reason for such arrangement on Fenton's [12] work on leaf-hopper parasites, according to which *Aphelopus* is the only genus of the Anteoninæ that parasitizes the Typhlocybinæ and is also the only genus that was found on the Membracidæ, and as such the Typhlocybinæ are considered the lowest subfamily of the Cicadellidæ, closest to the Membracidæ. Fenton shows that the Anteoninæ parasitize the Membracidæ, Cicadellidæ, and Fulgoridæ. Thus the three above families show close affinities. Because of the protective froth which envelops the young, the Cercopidæ escape parasitism.

Imms [13] also is of the opinion that the Membracidæ are most nearly related to the Cicadellidæ. Edwards [14] arranged the families so that the Membracidæ follow the Cicadellidæ, and the Fulgoridæ (Issidæ) follow the Cicadellidæ (Tettigometridæ). DeLong [15] places the Cicadellidæ between the Membracidæ and the Fulgoridæ. However, he admits the close relationship between the Cercopidæ and the Cicadellidæ. He says that *Penthimia americana* Fitch and certain species of *Gyponas* and the Acocephalini closely resemble the cercopids. The most striking of the Australian forms are the much larger species of the *Eurymela* group of genera comprising *Eurymela, Eurymeloides,* and *Eurymelops.* According to Tillyard,[16] these handsome wedge-shaped species superficially resemble the Cercopidæ. In my collection I have a *Poophilus,* a cercopid, that is so similar to this group that only examination of the tibial spurs will prevent its confusion with the leafhoppers. As a group, DeLong adds, the Fulgoridæ are most easily confused with the Cicadellidæ. Distant,[17] however, had the families arranged as follows:

[11] Kansas Univ. Bull. 12 (1920) 28.

[12] Ohio Journ. Sci. 18 (1918).

[13] A General Textbook of Entomology. Dutton & Co. Inc., New York (1929) 357.

[14] Hemiptera-Homoptera of the British Isles. L. Reeves & Co. (1896) 15.

[15] Conn. Geol. & Nat. Hist. Surv. Bull. 34 (1923) 58.

[16] The Insects of Australia and New Zealand. Angus & Robertson, Ltd. (1926) 164.

[17] Fauna Brit. Ind. Rhynch. 3 (1906) 52–54.

Cicadidæ, Fulgoridæ, Membracidæ, Cercopidæ. I do not clearly see the purpose of such arrangement. It seems that with the position and development of the ocelli, the antennæ, the pronotum, the wing texture, and the tibial spurs (spines), the following arrangement might be followed: The Cicadidæ are the lowest and most generalized of the Homoptera. The Membracidæ, due to the poor development of the nervous system and the peculiar absence of the forms, which explains the absence of the third ocellus (wings very generalized, simple genital organs), and the peculiar and useless development of the scutellum, come second. The Cercopidæ, with less bizarre form and texture of the wings, scutellum, the arrangement of the tibial spurs (nearer to Cicadidæ), the ocelli, and the antennæ, might be subordinated to the Cicadellidæ. They should be preceded by the Membracidæ, however, for the reason that some of them generally resemble the Membracidæ more closely. The species of *Machaerota* have the scutellar process long and arched, its apex extending in the same manner as that of the membracids. In *Machaeropsis* the scutellar process gradually shows recession. Distant [18] claims that the subfamily Machaerotinæ is the connecting link between the Membracidæ and the Cercopidæ, and the Cercopidæ should be subordinated to the Cicadellidæ. The Fulgoridæ, with the location of the antennæ (which are lower than in the Cicadellidæ) and the scutellar development, may be considered the most modern and specialized family of the Homoptera.

The Cicadellidæ belong to the division Trimera, and are one of the five families in this group; namely, the Cicadidæ, or "harvest flies," the members of which are the largest species of the group; the Fulgoridæ, or "lantern flies," which feed on the leaves and stems of herbaceous plants; the Membracidæ, or "treehoppers," which feed on twigs; the Cercopidæ, or "froghoppers," also known as "spittle bugs" because of the frothy masses that they make on the stems of grasses; and the Cicadellidæ, or "leafhoppers," which feed mostly on the leaves of plants. Kirkaldy [19] defines "leafhoppers" as a convenient, nontechnical term, to express auchenorhynchous Homoptera, excluding the Cicadidæ, but including the sternorhynchous family Psyllidæ (Chermidæ), generally known as "jumping plant lice."

[18] Op. cit. 4 (1908) 79.

[19] Rep. Exp. Sta. Haw. Sugar Planters' Assoc. Bull. 1 pt. 9 (1906).

The large family Cicadellidæ is separated from the other related groups by the more or less closely spinulose condition of the posterior tibia and the position of the ocelli. The position of this important family is still the subject of considerable difference of opinion among workers. Westwood recognized only three families in the order Homoptera; namely, Cicadidæ, Fulgoridæ, and Cercopidæ. Stål, supported by Hansen, recognized four; namely, Stridulantea, Cercopida, Fulgorida, and Jassida which include Membracida (Distant [20]). Edwards,[21] excluding Psyllina, enumerated fifteen families, which come under the present consideration of the group: Cicadellidæ, Ledridæ, with one genus; Ulopidæ, with one genus; Paropidæ, with one genus; Bythoscopidæ, Tettigonidæ, Acocephalidæ, Jassidæ, and Typhlocybidæ are considered families. Kirkaldy [22] placed under the superfamily Tettigonioidæ the family Tettigoniidæ with its subfamilies: Tettigoniinæ, Jassinæ, Agalliinæ, Penthimiinæ, Eupteryginæ, Ledrinæ, Stenocotinæ, Kahavaluinæ, and Megophthalminæ.

Baker [23] opposed what he termed the "antiquated artificial system" originally proposed for a few species formerly known in Europe; namely, if the ocelli are located on the disk, the specimen is a tettigoniellid; if on the margin, a jassid; and if on the face, a bythoscopid. He listed under the superfamily Jassoidea fifteen families; namely, the Tettigoniellidæ, the characteristics of which comprise those of the members of the *Tettigoniella* of Distant,[24] excluding the genera *Signoretia, Preta, Eucanthus,* and *Bundera;* the Gyponinæ, without the genus *Penthimia;* Penthimidæ, those of the genus *Penthimia;* Thaumatoscopidæ taking in the genera of Kirkaldy, *Thaumatoscopus* (allied to *Gypona,* and *Penthimia* and *Vulturnus* which I would consider a *Thaumatoscopus* itself—there is hardly sufficient reason for raising *Vulturnus* to the category of a genus); Ledridæ, those of the subfamily Ledrinæ; Paropidæ, taking the genera *Mesoparopia* of Matsumura and *Paropia;* Stenocotidæ with the genera *Stenocotes* and *Kyphocotes;* Koebelidæ, the genus *Koebelia;* the Ulopidæ, under which belong the genera *Ulopa* and *Moonia;* Signoretiidæ, *Signoretia* of Stål and *Preta*

[20] Fauna Brit. Ind. Rhynch. 3 (1906) 52–54.
[21] Hemiptera-Homoptera of the British Isles. L. Reeves & Co. (1896).
[22] Rep. Exp. Sta. Haw. Sugar Planters' Assoc. Bull. 1 pt. 9 (1906).
[23] Philip. Journ. Sci. 24 (1923) 57–71.
[24] Fauna Brit. Ind. Rhynch. 4 (1908) 201–202.

of Distant; Eucanthidæ, *Eucanthus* and *Bundera;* Pythamidæ, consisting of *Onukia, Pythamus,* and *Oniella;* Nirvanidæ, having *Kana* Distant, *Ophuchus* Distant, *Stenometopius* Matsumura, and *Nirvana* Kirkaldy; and the genera recently erected by Baker—*Pseudonirvana, Nirvanoides, Pythonirvana,* and *Jassonirvana.*

DeLong,[25] considering the Connecticut species, divides the Cicadellidæ into four subfamilies based principally upon the location of the ocelli and the shape of the body: Bythoscopinæ, Jassinæ, Cicadellinæ, and Gyponinæ. The Typhlocybini becomes a tribe of the Jassinæ. Distant, following in the main the classification of Van Duzee, divided the Cicadelli into seven subfamilies: Ledrinæ, Bythoscopinæ, Tettigoniellinæ, Gyponinæ, Acocephalinæ, Jassinæ, and Typhlocybinæ. However, the Acocephalinæ are absorbed by the Jassinæ in his synopsis of the genera.

Lastly, Melichar [26] divided this family into two large sections, based mainly upon the shape and sculpture of the vertex and pronotum; the Proconiaria with 54 genera, and the Cicadellaria with 100 genera. However, according to China,[27] many of Melichar's generic names were preoccupied. Inasmuch as Melichar's types and discussed species were from southern America, and in view of this radical change in classification, I shall mention his work only as a reference.

CHIEF CHARACTERISTICS OF THE CICADELLIDÆ

In the classification of the Philippine species described herein, the main features or characteristics of the groups were taken into consideration according to different authorities with special reference to the work of Distant [28] and of Osborn.[29]

Family CICADELLIDÆ Latreille

Cicadellæ LATREILLE, Fam. Nat. Reg. An. (1825) 427.
Cicadellina BURMEISTER, Handb. d. Ent. **11** (1835) 103.
Cicadellines BLANCHARD, Hist. des Ins., Hemip. (1840) 187.
Tettigoniidæ FITCH, Homop., Fourth Ann. Rep. N. Y. State Coll. Nat. Hist. (1841) 55.
Jassina STÅL, Stet. Ent. Zeit. **19** (1858) 234.
Jassidæ FIEBER, Verh. Zool.-Bot. Ges. Wien **16** (1866) 500.
Jassoidæ VAN DUZEE, Trans. Am. Ent. Soc. **19** (1892) 296.
Tettigonioidæ KIRKALDY, Exp. Sta. Haw. Sugar Planters' Assoc. Bull. **1** pt. 9 (1906) 295.

[25] Conn. Geol. & Nat. Hist. Surv. Bull. **24** (1923).
[26] Ann. Mus. Nat. Homop. **21** (1924) 195–243.
[27] Ann. & Mag. Nat. Hist. IX **20** (1927) 281.
[28] Fauna Brit. Ind. Rhynch. **4** (1908).
[29] Ohio Biol. Surv. **3** No. 4 (1928).

The family Cicadellidæ was divided into seven subfamilies; namely, Ledrinæ, Bythoscopinæ, Tettigoniellinæ, Gyponinæ, Acocephalinæ, Jassinæ, and Typhlocybinæ. As a matter of convenience, the groups under the subfamily Acocephalinæ were placed under Jassinæ.

The insects are comparatively small, ranging from 2 millimeters in length, including the tegmina, among the Typhlocybinæ, to 18 millimeters among the Ledrinæ; tibia more or less elongated, hind tibia characteristically armed with a double row of spurs; tarsi 3-jointed; ocelli two, placed on the anterior just slightly above the margin of apex, in the Bythoscopinæ in front, below the margin; in the Tettigoniellinæ, Gyponinæ, and Ledrinæ, on the vertex (sometimes variable in the Ledrinæ); and in the Typhlocybinæ the ocelli are wanting; the antennæ setaceus, 2-jointed, and terminated by fine long hairs, invariably placed between the frons and the eyes; the tegmina, or superior wings, are thicker than the membraneous, or inferior, wings, which are folded at rest.

In the Cicadellidæ the position of the ocelli; the shape, size, and sculpture of the vertex, pronotum, and scutellum; the shape and size of the frons and the clypeus; the arrangement of the venation; the coloration or markings; and the external and internal characters of the genitalia are the principal taxonomic features for the grouping and the separation of species.

LEDRINÆ

Head broad; face moderately concave or somewhat convex; vertex spatulate, horizontally reclined, narrowly depressed or moderately convex; cheeks flat and white, frons and clypeus narrowly produced; antennæ inserted under the anterior part of head above the line of the eyes and far from them.

The only species studied was a *Petalocephala* in the Osborn collection.

Genus PETALOCEPHALA Stål

Petalocephala Stål, Öfv. Vet.-Akad. Förh. (1853) 266.

Ledropsis Melichar (nec White), Hom. Fauna Ceylon (1903) 141.

Type, *P. bohemani* Stål, from Java.

Distribution: Ethiopian, Oriental, Malayan, and Australasian Regions.

Body very oblong or a little elongate, depressed; head clypeated, foliaceously produced anteriorly; vertex somewhat flattened; face beneath eyes strongly and abruptly, thence gradually, narrowed, margins very slightly defined; front small, narrow, flattish; eyes small; ocelli situated towards base of vertex, farther removed from the eyes than from each other; pro-

notum transversely sexangular, not, or only slightly, narrowed anteriorly, the lateral margins acute, anterior lateral much longer than posterior lateral, anterior margin slightly rounded; scutellum triangular, subequilateral; tegmina subcoriaceous pellucid, densely punctate, tectiform, anteriorly conjointly convex, clavus very broad before the middle, corium obliquely rounded at apex, veins somewhat irregularly anastomosed towards apex, legs somewhat short, anterior coxæ free, posterior tibiæ remotely dentate.—STÅL, translated by DISTANT, Fauna Brit. Ind. Rhynch. 4 (1908) 162–163.

PETALOCEPHALA CULTELLIFERA Walker.

Petalocephala cultellifera WALKER, Journ. Linn. Soc. Zool. 1 (1856) 98.
Ledra punctifera WALKER, List. Hom. Suppl. (1858) 249; ATKINSON, Journ. As. Soc. Bengal 54 (1885) 95.

Originally known from Sikhim; Mungphu (Atkinson collection); Darjiling (Brit. Mus.); Malay Peninsula; Perak (*Doherty*); Singapore (*Wallace*, Brit. Mus.) Distant.[30]

Length excl. tegmina, 15 to 17; exp. tegmina 28 to 32 millimeters.

Virescent or ochraceous; vertex about as long as breath between eyes, conically produced towards apex, thickly finely punctate, centrally longitudinally carinate; pronotum finely punctate, posteriorly finely rugulose, centrally longitudinally linearly impressed; tegmina thickly punctate; posterior tibiæ inwardly strongly dentate.—DISTANT, Fauna Brit. Ind. 4 (1908) 164.

LUZON, Mountain Province, Haight's Place, Balbalan (Osborn collection). This is the first Philippine record.

BYTHOSCOPINÆ

This subfamily is readily recognized by having the ocelli on the face below the anterior edge of the head, the vertex narrow or apparently wanting, the head being entirely deflexed.

Key to the Philippine genera of the subfamily Bythoscopinæ.

*a*¹. Tegmina without an appendix.
  *b*¹. Pronotum distinctly produced beyond the anterior margin of the eyes, and oblique rugæ .... *Macropsis* Lewis.
*a*². Tegmina with a distinct appendix.
  *b*¹. Pronotum not produced beyond the anterior margins of the eyes.
    *c*¹. Vertex with eyes much broader than pronotum, head rounded.
      *d*¹. Ocelli nearer the eyes than each other........ *Idiocerus* Lewis.
      *d*². Ocelli equidistant from each other and the eyes. *Idiocerinus* Baker.
    *c*². Vertex with eyes slightly broader than pronotum, transverse, head blunt, transversally depressed........ *Bythoscopus* Germar.
  *b*². Pronotum shorter and narrower than the scutellum and vertex together .... *Chunra* Distant.

[30] Fauna Brit. Ind. Rhynch. 4 (1908) 164.

Genus MACROPSIS Lewis

Macropsis LEWIS, Trans. Ent. Soc. Lond. 1 (1835) 49.
Pediopsis BURMEISTER, Gen. Ins. (1838) pl. 10.

The very narrow vertex is distinctly produced beyond the anterior margins of the eyes. The head is as wide as the pronotum. The lateral margins of the pronotum are short, the anterior margin as in *Tartessus*, the posterior concave, and the surface obliquely striated; the scutellum with a transverse depression before the apical angle, slightly broader than long; the tegmina thin and folded over the body as in *Bythoscopus*.

In this genus the males are darker and occasionally spotted (although the males of Nearctic species often show fewer markings than the females). The markings are not found in females of this genus, whereas in *Idiocerus*, a genus of the same subfamily, the spots are found in the females.

This genus, although apparently of world-wide distribution, has not been recorded from the Malayan region. Stål[31] described one species, *Macropsis maculipennis*, which is said to be a *Bythoscopus*. In Baker's collection there are several Japanese species determined by Matsumura under *Pediopsis*, which is a synonym of *Macropsis*. There are three specimens labeled *Macropsis*, but they belong to the genus *Bythoscopus*.

Breakey,[32] speaking of the geographic distribution, says that the genus is best known from the North Temperate Zone, and according to references found by him, ten species are described from the Ethiopian Region, four from Australia, one from Santo Domingo, eleven from the British Isles, outside of the thirty-two species and three varieties recognized by him as present in North America. Oshanin[33] recorded four species and one variety from Europe (one of them is a *Prosina* which was also recorded from Siberia), one from Japan, and two from China. Fowler[34] records two species of *Stragania* Stål, from Mexico, which were treated as a subgenus of *Gypona* and subsequently placed under the Jassinæ by Stål himself as being synonymous with *Macropsis* Lewis. In this paper (Hemiptera Africana 4: 126–127) he renamed *Bythoscopus olivaceous* Stål *Macropsis subolivaceous* Stål. Distant[35] described three species of *Pediop-*

[31] Öfv. Vet.-Akad. Förh. 27 (1870).
[32] Ann. Ent. Soc. Am. 25 (1932) 4.
[33] Ann. Mus. Zool. de Sci. 11 (1906) 67–69.
[34] Biol. Cen. Am. Rhynch. 2 pt. 1 (1909) 271.
[35] Fauna Brit. Ind. Rhynch. 6 (1916) 238–240.

sis (*Macropsis*) from India. These so far are the only *Macropsis* species known in the Indian fauna. Cogan [36] described one more species from Africa (*Pediopsis capensis*).

Specimens of the following nine new species were compared with Nearctic and Palæarctic species at the United States National Museum:

MACROPSIS BREAKEYI sp. nov.

Female, length, including tegmina, 3 millimeters; male, length, including tegmina, 2.8.

Very small, robust, ochraceous all over, vertex regularly and transversely punctured with brown punctures, and transversely striated, about one-fourth as long as the distance between eye and middle of vertex; pronotum extended anteriorly, right-angled, median line indistinct, oblique striation rugulose, regularly punctured with brown, posterior angles in line with scutellum, oblique; posterior side slightly concave. Scutellum lightly punctured; face slightly tumid, appearing rugose from the side, clypeus minute, lora and gena almost invisible, ochraceous; plates of male long and spindling; the last ventral segment of female almost truncate, slightly projected at middle; pygofers very large; tegmina sordid hyaline, profusely and finely punctured with brown punctures.

MINDANAO, Zamboanga (holotype, Baker collection, U. S. N. M.).

I take pleasure in naming this beautiful species for Dr. E. P. Breakey, of the Department of Zoölogy and Entomology, Ohio State University, a homopterist to whom I am indebted for valuable suggestions and criticism during the progress of this work.

MACROPSIS RIZALI sp. nov.

Female, length, 4.5 millimeters.

Head, pronotum, and scutellum yellow; face, legs, and body beneath ochraceous, with brownish markings on the abdominal segments and pygofer, somewhat slender in form. Tegmina long, greenish transparent, with venation prominent, deeper green and yellowish green. Slender and medium-sized species. Pronotum regularly rugose, lightly marked with brownish patch on the anterolateral angle, prominently produced, anteriorly almost right angled, posterior side slightly concave. Median line obsolete; scutellum subtriangular, slightly broader than long, finely punctured; face broad, slightly tumid when viewed from

[36] Ohio Journ. Sci. 14 (1916).

side, forehead regularly and finely striated; frons elongated, slightly differentiated by shallow sulci; clypeus short and broadly rounded; lora minute, narrow, and elongated; gena narrow and elongated, depressed below the area of face, broader at apex; last ventral segment a projecting semicircular plate, slightly notched.

MINDANAO, Zamboanga Province, Dapitan (type and paratype, Baker collection, U. S. N. M.).

I am naming this species for the foremost Philippine hero, Dr. Jose Rizal, physician and scientist, who spent a few years in Dapitan as a political exile during the Spanish domination of these Islands.

MACROPSIS BENGUETENSIS sp. nov.

Female, length, 6 millimeters; male, length, 5.

Pale ochraceous with profuse brown and fuscous markings on the pronotum and scutellum, tegmina light brown with profuse fuscous markings. Male slightly darker.

Vertex almost invisible from dorsal view, obtuse-angled, at the middle much narrower than the portions close to the eyes, appearing as a line; pronotum obtuse-angled, broader than long, moderately convex, with a very distinct fuscous blotch or marking on each side of the anterior line, midway between the anterolateral and the median line which is slightly carinate or ridged, the oblique ruga, starting from the upper middle portion to the lower side and gradually to the umbral angle, very prominent and roughly punctured; middle portion of the pronotum profusely marked with brown; scutellum ochraceous, roughly punctured, posterior angle sharply pointed and separated by an arcuate suture, somewhat striated with transverse striæ on upper-lateral angle, with obliquely triangular fuscous markings; face ochraceous, broad, almost flat, slightly tumid on the clypeal portion, contour slightly rough, coarsely and profusely punctured; frons sordid, tinged with ferruginous, especially in males; eyes brown with slight fuscous blotch on inner portion, loræ and genæ minute, ocelli on the face between eyes and frons; antennæ minute, beneath the inner posterior angle of the eyes, above the deeply sulcated cheek; pectus and venter ochraceous with fuscous markings on the portions of the prosternum and metasternum, femora, tibiæ, and tarsi, especially noticeable in males, tegmina membranous brown, strongly corrugate, sordidly marked with irregular fuscous markings; venation prominent, ochraceous, stippled with fuscous. A robust species.

LUZON, Benguet Subprovince, Baguio (type and allotype, Baker collection, U. S. N. M.).

MACROPSIS FUSCOVENOSA sp. nov.

Male and female, length, 4 millimeters.

Pronotum and scutellum of the female grass green, the pronotum of the male pale brown with profuse fuscous punctures, the scutellum of the same color and with the same punctures, and with one fuscous triangular marking on each of the three angles; eyes grayish with crimson tinge; the face, pectus, legs, and venter of female greenish ochraceous, with brown markings on the legs; those of the male ochraceous, with brown punctures on the face, and brownish markings on the legs. Dimorphism is distinct in this species.

Pronotum convex, slightly less than a right angle, oblique impressions prominent, median line present, about two-thirds as long as broad, the posterior side narrowed and concave; scutellum almost as long as broad, as long as the pronotum, median line present, posterior angle separated with arcuated suture, with coarse brown punctures, face with median line also, rough surface, slightly longitudinally carinate on the middle; gena small and depressed, narrow margin extended to the base of clypeus, which is also small and narrowed at apex; the plates of the genitalia slender and elongate (filiform), the last ventral segment of the female small, wedge-shaped; tegmina long, smoky pale brown with very prominent fuscous venation.

LUZON, Benguet Subprovince, Baguio (type and allotype, Baker collection, U. S. N. M.).

MACROPSIS FUSCOPUNCTATA sp. nov.

Female, length, about 4.75 millimeters.

Greenish ochraceous with sordid brown promiscuous punctures all over head, face, pronotum, scutellum, and tegmina, quite similar in form to *M. fuscovenosa*, but slightly larger; pectus and legs with brownish markings.

Pronotum distinctly angulate anteriorly, rectangular, median line distinct, striæ profusely punctured with brown dots, rugulose, posterolateral angles rounded, middle posterior side slightly concave; scutellum greenish ochraceous, with median line profusely punctured with brown spots, especially the three angles, the posterior separated by an arcuated suture; face roughly striated and punctured, sordidly marked with brown markings, oblique striation from middle to the eyes deep, median line present, reaching nearly to clypeus; frons distinguished by two

parallel, semicircular, brown lines, clypeus broadly rounded; lora and gena small; pectus and legs with brown markings; venter greenish ochraceous; last ventral segment transversely triangular, wedge-shaped; tegmina smoky hyaline, long, with profuse brown punctures, especially the commissural region; venation punctured all over with brown.

LUZON, Benguet Subprovince, Baguio (type and paratype, Baker collection, U. S. N. M.).

MACROPSIS OTANESI sp. nov.

Female, length, 4.25 millimeters; male, length, 4.25.

Testaceous to fuscous, medium-sized; face, pectus, legs, and venter ochraceous, with a brown tinge, the upper portion of the head semitransparent fuscous. Vertex very narrow and projected in front, about one-fifth as broad as the distance between the eye and one-half of the vertex; pronotum testaceous, with short, fine, oblique striation, regularly and profusely punctured with fuscous punctures, median line absent, acutely angled, slightly more than right-angled, about three-fourths as long as wide between humeral angles, posterior side subtruncate; area of scutellum more testaceous and less thickly punctate, lateral angles smoothly brown, transversal suture separating the posterior angle; face smoothly rugose, ocelli ochraceous, situated between and near the eyes; legs and venter ochraceous with brownish tinge; pygofer orange-brown; the plates castaneous; tegmina fuscous to castaneous, with irregular fuscous markings.

BASILAN (type and allotype). MINDANAO, Zamboanga (paratypes, Baker collection, U. S. N. M.).

I take pleasure in naming this species for my friend and loyal assistant Mr. F. Q. Otanes, of Manila, who from time to time has supplied me with homopterous insects for determination.

MACROPSIS BASILANA sp. nov.

Female, length, including tegmina, 5 millimeters.

Dark brownish ochraceous, vertex, pronotum, and scutellum ochraceous with a brown marking on each basal angle of scutellum; tegmina sordid hyaline, brown with fuscous markings at the ends of principal veins, and division of principal cells, face, pectus, venter, and legs ochraceous, pygofer with a brown patch on the middle of each sheath; ovipositor exceeds the length of the pygofer considerably, as long as tegmina or slightly longer; vertex acutely produced, slightly more than right-angled, about one-fourth as long as the distance from the middle to the eyes;

transversely and briefly striated, finely punctured, with fine testaceous dots; pronotum with same color ornamentation and sculpture as the vertex, produced slightly more than a right angle in front, posterior side somewhat concave, markings on center and posterior side darker than rest, median line absent; face, forehead center semihyaline, brown, rugose; clypeus, lora and gena minute, similar to *M. otanesi,* but relatively slenderer and longer, especially the ovipositor.

BASILAN (type). MINDANAO, Zamboanga (paratype, Baker collection, U. S. N. M.).

MACROPSIS LUZONENSIS sp. nov.

Female, length, including tegmina, 4.5 millimeters; male, length, including tegmina, 4.

Yellowish brown; pectus and legs of female brownish ochraceous, with brown tinge on venter and pygofer; those of male greenish ochraceous; tegmina similar to those of *M. basilana,* but the markings finer, the colors similar to *M. basilana,* but size and general conformations similar to those of *M. otanesi.*

Vertex very short, about one-fourth as long as the distance from the center to the eye, greatly produced in front, slightly more than right-angled; anterior side of pronotum greatly produced, median line absent, oblique striation and punctures fine and concolorous, about two-thirds as long as broad, anterior angle concave; scutellum slightly lighter, posterior angle impressed before apex.

LUZON, Laguna Province, Mount Maquiling (type and paratypes, Baker collection, U. S. N. M.).

MACROPSIS DAPITANA sp. nov.

Female, length, including tegmina, 5.5 millimeters.

Vertex short, longer at the side near the eye, middle portion a mere line, olive-brown, regularly punctured; pronotum roundly produced, less than right-angled, about twice as broad as the length, coarsely and regularly punctured; posterior side roundly and gradually concave, scutellum orange-brown, equilaterally triangular, regularly and finely punctured; face roundly tumid, olive-brown; pectus black; legs and venter brown; last abdominal segment trisinuate; tegmina olive-brown, venation orange-brownish.

MINDANAO, Zamboanga Province, Dapitan (type anu paratypes, Baker collection, U. S. N. M.).

MACROPSIS DAVAOENSIS sp. nov.

Female, length, including tegmina, about 3 millimeters.

Similar in size and shape to *M. mindanaoensis*. Vertex and pronotum greenish ochraceous, fine striation and punctures concolorous, median line indistinct; scutellum yellowish ochraceous with fine brown punctures all over, apical angle with shallow and short impressed suture; tegmina hyaline, sordid brown with profuse brown to fuscous spots; face greenish ochraceous, slightly tumid and finely stippled; pectus, legs, and venter brownish ochraceous with brown markings.

MINDANAO, Davao Province, Davao (type); Lanao Province, Iligan (paratype, Baker collection, U. S. N. M.).

Genus IDIOCERUS Lewis

Idiocerus LEWIS, Trans. Ent. Soc. Lond. 1 (1836) 47.
Idioscopus BAKER, Philip. Journ. Sci. § D 10 (1915) 338.

Type, *I. adustus* H. S., a Palæarctic species.

The head is broad and very short, the vertex merging into the front. The eyes prominent, the elytra long, usually narrowing toward the tip, the body appearing wedge-shaped and the nervures are strong, often being set with tubercles or papillæ alternately. The male antennæ are peculiar in having swollen disc-like portions near the tips of the setæ.—OSBORN and BALL, Proc. Davenport Acad. Nat. Sci. 7 (1898) 124.

According to Osborn,[37] "the larvae differ from other tree inhabiting forms in having broad heads and thorax and long slender cylindrical abdomen." They are found most abundant and in swarms during the dry weather from February to April.

Baker [38] made *Idiocerus clypealis* Lethierry the type of a new genus *Idioscopus* and included therein two new species, *palawanensis* and *tagalicus*, because, he states, the head is larger, narrower, and longer as seen from above. He says that it is distinctly longer at the middle than at the eyes, that it is long in proportion to width between eyes, and that the first apical and first subapical cells are confluent. The generic characteristics of this species seem to tally exactly with those of *Idiocerus*, as given by Distant from Osborn and Ball.[39]

IDIOCERUS CLYPEALIS Lethierry.

Idiocerus clypealis LETHIERRY, Journ. As. Soc. Bengal 58 (1889) 252; ATKINSON, Ind. Mus. Notes 4 (1891) 187; DISTANT, Fauna Brit. Ind. Rhynch. 4 (1908) 187.

[37] Ohio Biol. Sur. 3 (1928) 209.
[38] Philip. Journ. Sci. § D 10 (1915) 317–343.
[39] Proc. Davenport Acad. Nat. Sci. 7 (1898) 124.

Idiocerus nigroclypeatus MELICHAR, Hom. Fauna Ceylon (1903) 148, pl. 5, fig. 1, *a*, *b*.
Idioscopus clypealis Lethierry, BAKER, Philip. Journ. Sci. § D 10 (1915) 339–340.

Female.—Length, including tegmina, 4 millimeters.

Head, viewed from above, large, broad, and short, the eye exceeding the pronotum, the vertex being only one-half as long as broad from the middle to the eye; apical cells four; anteapical three; tegmina wedge-shaped, longer than the abdomen, being narrowed and folded behind, the exact characteristics for the genus. Distant, however, in describing it, did not state that it is the male that lacks the two spots on the anterior margin of head, a sexual characteristic. Neither did he mention the fact that it is the male that has the immaculate face, and that the female has two small spots on the frons between the eyes, another sexual differentiation.

Distant [40] stated that the clypeus is flavescent with a central longitudinal black facia; this feature is also absent. All of my specimens, male and female, have a uniform clypeus. The two spots on the apex of the vertex and the two on the frons are absent in the male.

"Habitat: Bengal, Calcutta, Pusa, Madras, Ceylon, Peradiniya, Colombo." (Distant.)

LUZON, Laguna Province, Los Baños (*Baker*). MINDANAO, Occidental Misamis Province, Oroquieta (*Merino*), on mango. Baker believes that this species occurring in swarms is as injurious to the mango plant as *C. niveosparsa*.

Genus IDIOCERINUS Baker

Idiocerinus BAKER, Philip. Journ. Sci. § D 10 (1915) 241.

Type, *I. melichari* Baker.

This genus was erected by Baker [41] on the form of the frons which, according to him, is different from any other Philippine idiocerine insect. The clypeus is shorter compared to its width than in the other nearly related groups. Perhaps also the absence of the upper cubital branch of the wing veins and the reduction in size of the second apical cell are unique. Other characteristics are typical of *Idiocerus*.

[40] Fauna Brit. Ind. Rhynch. 4 (1908) 187.
[41] Philip. Journ. Sci. 10 (1915) 241.

IDIOCERINUS BAKERI sp. nov.

Female, length, including tegmina, 4.5 millimeters.

Vertex virescent with olivaceous area on the median occupying two-thirds of the apex; frons and clypeus orange, cheeks and lora ochraceous, clypeus short and wide; pronotum with slightly more than two-thirds of the posterior area testaceous and the anterior third virescent, transversely more than twice as long as the vertex; anterior margin rounded, posterior broadly truncate; scutellum equilateral, longer than the pronotum, testaceous; body beneath and legs ochraceous; last ventral segment truncate; tegmina long, apical cells four, the second outer reduced, upper cubital branch inconspicuous with distinct appendix, claval area olive-green, the rest brown, venation fuscous, a longitudinal fuscous fascia from humeral angle to apical margin, a fuscous patch at margin within the first and second apical cells.

LUZON, Laguna Province, Los Baños (type in my collection).

I am naming this species in honor of the late Prof. Charles Fuller Baker, under whom I did my first field work in entomology.

Genus BYTHOSCOPUS Germar

Bythoscopus GERMAR, Silb. Rev. Ent. 1 (1833) 180; LEWIS, Trans. Ent. Soc. Lond. 1 (1836) 48; FIEBER, Verh. Zool.-Bot. Ges. Wien 18 (1868) 450–456; Rev. Mag. Zool. (3) 3 (1875) 389; KIRKALDY, Ent. 34 (1901) 340; Exp. Sta. Haw. Sugar Planters' Assoc. Bull. 1 (1906) 345; 3 (1907) 31; DISTANT, Fauna Brit. Ind. Rhynch. 4 (1908) 190; VAN DUZEE, Ottawa Nat. 26 (1912) 69.

Batrachomorphus LEWIS, Trans. Ent. Soc. Lond. 1 (1835) 51; WESTWOOD, Intr. Mod. Cassif. Insects 2 Synop. (1840) 117; KIRKALDY, Ent. 34 (1901) 219 (names *irroratus* type).

Macropsis AMYOT and SERVELLE, Hem. (1843) 585; FIEBER, Verh. Zool.-Bot. Ges. Wien 18 (1868) 449; STÅL, Hem. Afr. 4 (1866) 126; KIRSCHBAUM, Cicad. 5 Wiesbd. (1868) 16; SAHLBERG, Cicad. (1871) 113; FIEBER, Cicad. d'Eur. 1 (1875) 101; MAYER, Tabellen (1884) 26; EDWARDS, Trans. Ent. Soc. Lond. (1886) 104; ASHMEAD, Ent. Am. 5 (1889) 126; VAN DUZEE, Ent. Am. 5 (1889) 165; Trans. Am. Ent. Soc. 21 (1894) 256; BALL, Psyche 9 (1900) 128; OSHANIN, Verz. Palae. Hem. 2 (1906) 67; Kat. Palae. Hem. (1912) 101; DELONG, Tenn. St. Bd. Ent. Bull. 17 (1916) 9.

Stragania STÅL, Rio Jan. Hem. 2 (1862) 49; FOWLER, Biol. Centr. Am. Hom. 2 (1903) 316.

Pachyopsis UHLER, Bull. U. S. Geol. Surv. 3 (1877) 466 (type *lætus* Uhler); ASHMEAD, Ent. Am. 5 (1889) 165.

Gargaropsis FOWLER, Biol. Centr. Am. Hom. 2 (1896) 167.

Type, *B. lanio* Linnæus.

Distribution: Universal.

General appearance broad and robust, head short and bluntly rounded, face broad and short; frons greatly raised from cheeks; pronotum slightly wider than long, coarsely transversely striated, anterior margin rounded, posterior margin slightly concave, almost truncate; posterolaterals oblique, slightly rounded at corners; tegmina moderately long and tapering towards the end, the tip narrow and rounded: venation reticulated or longitudinally punctured.

Distribution: Bengal, Calcutta, Ceylon, Tenassarim.

BYTHOSCOPUS CHLOROPHANUS Melichar.

Bythoscopus chlorophanus LETHIERRY (*Pachyopsis*), Bull. Soc. Zool. Fr. (1892) 209; MELICHAR, Hom. Fauna Ceylon (1903) 153; DISTANT, Fauna Brit. Ind. Rhynch. 4 (1908) 191, fig. 124; MELICHAR, Notes Leyd. Mus. 35 (1914) 121; OSBORN, Pacific Ent. Pub. 7 (1934) 241.

Male, length, about 4.5 millimeters; female, length, about 5.

Vertex, pronotum, and scutellum light green to stramineous, tegmina greenish ochraceous with piceous spots at end of clavus, face yellowish ochraceous to stramineous, body beneath and legs greenish ochraceous. Vertex narrow and broad, its length about one-sixth the distance between the eyes. Vertex with the eyes narrower than the pronotum; pronotum slightly broader than long, transversely striated, anterior margin rounded, posterior margin almost truncate; scutellum subtriangular, slightly narrower than broad, apical angle impressed with transverse line and separated by an arcuate impressed line, the rest finely punctured; eyes brick red; ocelli nearer to the eyes than to each other, face broad and short, surrounded by short striæ; venation longitudinally punctured.

This species is here reported from the Philippines for the first time.

LUZON, Laguna Province, Los Baños, Mount Banahao: Bataan Province, Mount Limay. MINDANAO. PALAWAN.

Genus CHUNRA Distant

Chunra DISTANT, Fauna Brit. Ind. Rhynch. 4 (1908) 193; BAKER, Philip. Journ. Sci. § D 10 (1915) 324–326.

Type, *C. puncticosta* Walker.

Distribution: Oriental and Malayan Regions.

Vertex very short and broad, with eyes distinctly broader than pronotum; face narrowed between eyes, the ocelli about as near to each other as to eyes and placed a little below middle of eyes, which are obliquely long and narrow and extend along the lateral margins of the pronotum; pronotum twice as long as vertex, the posterior margin concavely sinuate;

scutellum very long and broad, longer than pronotum and vertex together, transversely impressed before apical area which is moderately raised, the apical margin broadly subacute; legs moderately slender, the posterior tibiæ thickly spinulose, tegmina with the clavus posteriorly broadened to middle and then angularly narrowed to the claval apex, apical areas four, the upper or postcostal area short and moderately broad; wings ample.
—DISTANT, loc. cit.

CHUNRA NIVEOSPARSA Lethierry.

Chunra niveosparsa LETHIERRY, Journ. As. Soc. Bengal 58 (1889) 252; ATKINSON, Ind. Mus. Notes 1 (1889) 5; No. 4 (1891) 187, pl. 12, fig. 6; Journ. As. Soc. Bengal 72 pt. 11 (1903) 7; BAKER, Philip. Journ. Sci. § D 10 (1915) 318; 324–326.
Idiocerus basalis MELICHAR, Hom. Fauna Ceylon (1903) 147.
Idiocerus niveosparsus DISTANT, Fauna Brit. Ind. Rhynch. 4 (1908) 185, fig. 121.

Female, length, including tegmina, 4.25 millimeters.

Vertex ochraceous with large discal fuscous or olivaceous spots; front, clypeus, lora, and rostrum brown, cheeks ochraceous, ocelli fuscous, located just above the suture of the rounded frons, the distance between them twice the distance between ocelli and eyes; eyes olivaceous; pronotum transverse, about three times as long as length of vertex, rounded anteriorly, the lateral margin oblique and the posterior broadly sinuate, with olivaceous marking posteriorly, anterior margin lighter; scutellum equilateral, bronzy olive, as long as the pronotum, posterior angles light ochraceous, almost white, three spots of similar color above this; tegmina darker bronzy olive, white transversal band from humeral angle to the posterior angle of scutellum, white marking at the posterior tip of the scutellum, and at posterior extremity of costal area; white marking of costal area preceded by fuscous; venation and posterior margin fuscous.

Habitat: Saharanpur, Calcutta, Madras, Bombay Province, Jatalpur, Ceylon, Perademya, Pattipola.—DISTANT, loc. cit.

Baker [42] reported this insect from the Philippines and other Malayan countries, where it attacks mango flowers in swarms. He disagrees, however, with the description and the illustration of Distant, and places the Philippine species under the genus *Chunra*. Of this species he described three new varieties; namely, *Chunra niveosparsa* Leth. var. *philippinensis*, var. *palawensis*, and var. *lagunensis*.

The species described above from Oroquieta, Mindanao, tallies somewhat with the synopsis for var. *palawensis* Baker. The

[42] Philip. Journ. Sci. § D 10 (1915) 324–326.

frontoclypeal suture as shown in Distant's figure is not quite visible, moreover the marking on the scutellum is different from that of Distant.[43] Baker, however, was apparently in error in the discussion of this species. His citation referred to *Idiocerus niveosparsus* Lethierry, but his discussion was about the genus *Chunra* Distant. The Philippine species, however, is a *Chunra* and not an *Idiocerus*.

This species is associated in the Philippines with *Idiocerus clypealis* Lethierry, which is destructive to mango trees, sucking the juices of the young shoots and the flowers, and causing the latter to wither and fall. Trees severely attacked produce few or no fruits. Mango growers in the Philippines smudge their trees daily long before inflorescence, some during the months of March and April. Spraying with soap solution or with nicotine sulphate just before the mango flower opens has been successful.

These two leaf hoppers are the most pernicious mango pests in the Philippines.

TETTIGONIELLINÆ

This subfamily is easily recognized by the presence of the ocelli on the disk of the vertex, the large and prominent convex face, with long narrow cheeks, and the rounded or obtuse edge of the head.

Distant's synopsis includes eleven genera. Two other genera were described under this subfamily, making thirteen genera in all. I have added *Makilingia* by Baker.[44] I have followed, in the main, the great work of Distant. The following is a tentative key to the genera considered in this paper:

Key to the Philippine genera of the subfamily Tettigoniellinæ.

a^1. Face neither centrally carinate nor foveate.
- b^1. Lateral margins of vertex at the central margin of the eyes.
  - c^1. Vertex not foveate .... *Cicadella* Latreille.

a^2. Face globose; two carinations united posteriorly on basal area.
- b^1. Lateral margins of vertex at the central margin above the eyes.
  - c^1. Vertex flattish or concave.. *Makilingia* Baker.
- b^2. Lateral margins of vertex at the central margin of the eyes.
  - c^1. Vertex with a fine central longitudinal carination and an oblique carination on each side of anterior area............ *Mileewa* Distant.

Genus CICADELLA Latreille

Cicadella LATREILLE, in Cuvier, Regne Animal 3 (1817) 406; KIRKALDY, Can. Ent. 39 (1907) 249; VAN DUZEE, Check List Hem. (1916) 66.

[43] Fauna Brit. Ind. Rhynch. 4 (1908) 193–194.
[44] Philip. Journ. Sci. 24 (1924) 57–70.

Tettigonia REAUMUR, Memoirs 5 (1740) 150 (pre-Linnean); GEOFFROY, Hist. Abreg. des Ins. 1 (1762) 429, nom. praeocc.
Cicada FABRICIUS, Syst. Ent. (1775) 682 (name cited in error); *Cicada viridis* LINNÆUS, Syst. Nat. 1 (1758) 438.
Ablycephalus CURTIS, Brit. Ent. 1 (1833) 193.
Tettigoniella JACOBI, Zool. Jahrb. 19 (1903) 778, nom. nov.; DISTANT, Fauna Brit. Ind. Rhynch. 4 (1908) 201.

Type, *C. viridis* Linnæus, a Palæarctic species.

Vertex anteriorly convexly or subangularly produced, the lateral margins in a line with the inner margins of the eyes; face moderately globose, neither carinate nor foveate, moderately elongate, lateral areas transversely striate; pronotum longer than vertex, the anterior margin more or less convex, posterior margin truncate; scutellum somewhat small, transversely impressed before the apical area; tegmina longer than abdomen, apical areas five; posterior tibiæ longly spinulose.—DISTANT, loc. cit.

Most of the specimens in this collection are dark chocolate-brown with ferrugineous head and upper third of pronotum; eye pitch black, apex of tegmina dark copper brown; the frons somewhat triangular, about as long as broad between eyes, ferruginous with the middle depressed and slightly streaked with light brown, laterally slightly striated; division of clypeus hardly visible, gena and lora light ochraceous; pectus ochraceous, legs ferruginous, two anterior pairs of tibia and tarsal joints fuscous; venter orange with black band on the anterior halves of every segment; the last ventral segment ochraceous. There is a gradation of color from chocolate to dark brown among the specimens in my collection.

CICADELLA (TETTIGONIA) LONGA Walker.

Male, length, about 13 millimeters; female, length, about 14.

Ferruginous, slender, linear, pale, tawny beneath; head convex in front; face obtuse with a tawny disk; sides of the abdomen luteous; forewings with a black interrupted stripe near the hind border, and another more indistinct in the disk, hind-wings coppery.—WALKER, List. Hom. 11 (1851) 740.

LUZON, Rizal Province, Novaliches: Laguna Province, Los Baños.

According to Distant [45] this species is synonymous with *C. ferruginea*. However, China in one of his determinations in the Baker collection labeled this species as distinct from *C. ferruginea*.

[45] Fauna Brit. Ind. Rhynch. 4 (1908) 202–203.

CICADELLA FERRUGINEA Fabricius.

Tettigoniella ferruginea FABRICIUS (*Cicada*), Ent. Syst. 4 (1794) 32; Syst. Rhyng. (1803) 62; GERMAR (*Tettigonea*), Mag. Ent. 4 (1821) 69; SIGNORET, Ann. Soc. Ent. Fr. (1853) 676, pl. 22, fig. 5; WALKER, List Hom. Suppl. (1858) 218; ATKINSON, Journ. As. Soc. Bengal 54 (1885) 98.

Tettigonia apicalis WALKER, List Hom. 3 (1851) 736.

Tettigonia confinis WALKER, List Hom. 3 (1851) 736.

Tettigonia addita WALKER, List Hom. 3 (1951) 737.

Tettigonia gemina WALKER, List Hom. 3 (1851) 737; MELICHAR, Hom. Fauna Ceylon (1903) 155.

Tettigonia obscura WALKER, List Hom. 3 (1851) 738.

Tettigonia duplex WALKER, List Hom. 3 (1851) 738.

Tettigonia reducta WALKER, List Hom. 3 (1851) 739.

Tettigonia immaculata WALKER, List Hom. 3 (1851) 740.

Male, length, including tegmina, about 13 millimeters.

The last ventral segment of the female is deeply sinuate at the middle and roundly angled at the extremities of the lateral side. That of the male is almost truncate, with the anal plates acutely triangular. It almost entirely covers the pygofer. Of the distinguishing characteristics of this species the yellow abdomen with a semicircular black spot at the base of both lateral sides of each segment is unique.

Habitat: India, Burma, Malay Peninsula, Java, Sumatra, Borneo, Philippines, China, and Japan.

LUZON, Manila.

CICADELLA IMPUDICA Signoret.

Tettigonia impudica SIGNORET, Ann. Soc. Ent. III 1 (1853) 132 and 677 (Manila); STÅL, Hem. Ins. Philippinarum 2 (1870) 733; TASCHENBERG, Zeits. Natur 57 (1884) 430 (Siam).

Tettigoniella impudica Signoret, BAKER, Philip. Journ. Sci. § D 4 (1909) 553; 5 (1910) 50 (Palawan).

Female, length, including tegmina, 13 millimeters; male, length, including tegmina, 5.

Reddish brown, slender, linear, head convex in front; face obtuse; frons and clypeus reddish brown; gena and lora grayish brown; frons with reddish orange longitudinal band on the center, dimly laterally and perpendicularly striated; vertex sulcated between eyes and ocelli; eyes fuscous; tegmina long, fuscous, brown at apex; body beneath pectus reddish brown in female and ochraceous in male; venter reddish brown, dorsally black; posterior wings black.

This species is similar to the two preceding species, but is slightly smaller and slenderer and lighter brown. The last ventral segment of the female is obtusely and somewhat roundly pro-

duced with a ridge at the center that is slightly lobed. The anal plates of the male are longer with a long filiform appendage about two-thirds as long as the rest of the plate slightly passing the pygofer; pygofer is more robust and profusely pilose.

Cicadella impudica has been found associated with *C. longa.*

Described by Signoret from a specimen collected in Manila. It is not known from anywhere else.

CICADELLA PHILIPPINA Walker.

Cicadella philippina WALKER, List Hom. Ins. 3 (1851) 740.
Tettigonia philippina SIGNORET, Ann. Soc. Ent. III 1 (1853) 122 and 674, pl. 22, fig. 3; STÅL, Öfv. Vet.-Akad. Förh. 27 (1870) 733.

Female, length, including tegmina, 15 millimeters; males, length, including tegmina, 14.

Head, pronotum, and scutellum pitch black; vertex anteriorly rounded and bluntly produced, with a lateral marginal yellow fascia just before each eye, a median marginal fascia extending from the outer part of the vertex forward on to the front; ocelli amber yellow; eyes black, surrounded by a narrow ochraceous line; frons tumid, about one and one-half times as long as broad, margined by black fascia uniting just above the clypeus; frons separated by a compressed black line, hardly discernible; gena and lora yellow; pronotum slightly transverse, slightly broader than long, basal side bluntly rounded, lateral side almost parallel, the marginal somewhat inwardly sinuate, the two lateral yellow markings occupying almost two-thirds of area of the pronotum; scutellum and equilateral triangle with large, median, basal yellow marking; tegmina cherry red to fuscous. In males the commissure region and the costal area margined with black bands. The females with yellow patches as on the basal claval and on the basal costal regions, surrounded by dark fuscous areas, the rest of tegmina brown to cherry red; venation fuscous; body beneath, pectus, and legs ochraceous-brown; abdominal region above black; venter fuscous with ochraceous terminal band on each segment; last ventral segment in female acutely angled on the lateral edges, slightly more acute than in *Cicadella longa.* Anal plates of the male similar to those of *C. longa, C. ferruginea,* and *C. impudica.* Female darker than the male ventrally.

The Baker collection from various parts of Mindanao contains a female of the coloration of the male described with specimens collected in Iligan, Kolambugan, and Butuan. Some

of the specimens from Butuan are still darker with lighter areas on the middle extending down to the apices. This is true also of the specimens from Surigao. Some of these have the pronotal markings continuous, while those of the vertex are indistinct.

MINDANAO, Zamboanga Province, Port Banga: Lanao Province, Mumungan (Osborn collection).

CICADELLA SPECTRA (Distant).

Tettigonia albida WALKER, List Hom. Insects **3** (1853) 767; SIGNORET, Ann. Soc. Ent. France (1853) pl. 21, fig. 3; STÅL, Hem. Afr. **4** (1866) 117; Öfv. Vet.-Akad. Förh. **27** (1870) 734; KIRKALDY, Entomologist **23** (1900) 294; BREDDIN, Albi. Senah Nat. Ges. **25** (1900) 192; Albi. Naturf. Ges. Halli **24** (1901) 31; MELICHAR, Hom. Fauna Ceylon (1903) 157; Wien. Ent. Zeits. **24** (1905) 29; KIRKALDY, Exp. Sta. Haw. Sugar Planters' Assoc. Bull. **1** pt. 9 (1906) 319; BIERMAN, Notes Leyd. Mus. **29** (1907); **33** (1910) 52 (nec Walker).

Tettigonia negrilinea STÅL, Öfv. Vet.-Akad. Förh. **27** (1870) 735.

Tettigoniella spectra DISTANT, Fauna Brit. Ind. Rhynch. **4** (1908) 211–212, fig. 137; MATSUMURA, Insek. Zuckerrohr Formosa (1910) 27; DISTANT, Ins. Transvaal pt. 10 (1910) 233, fig. 41 (South Africa); MELICHAR, Notes Leyd. Mus. **36** (1913) 123 (Java); DISTANT, Fauna Brit. Ind. Rhynch. **7** (1918) 3; FLETCHER, Proc. 3d Ent. Meeting, Pusa (1918) 177; DAMMERMAN, Landbouwdierk, Oost. Ind. (1919) 170; FLETCHER, Proc. 3d Ent. Meeting, Pusa **1** (1920) 274.

The four black spots on the vertex do not appear in Walker's description.

Distant [46] gives a new name for *spectra,* and according to him the localities are the following: Calcutta, E. Bengal, Pusa, Nepal, Janakpur, Uagpur, Surat, Bombay, Ceylon, Peradeniya, North Australia, etc. No mention is made of the Philippines. He quotes E. E. Green about this insect, who says, "Makes itself a nuisance, swarming round lamps in the rooms at night," and N. Annandale, "Common at the edge of tanks. It is able to walk." Kirkaldy [47] gives us additional records of Queensland, Celebes, and the Philippines, where it is found on sugar cane and various grasses, and Stål [48] of Madagascar and West and South Africa.

In the Philippines this species is very common, swarming around lamps during the early part of the rainy season. It has been collected from Luzon to Mindanao.

[46] Fauna Brit. Ind. Rhynch. **4** (1908) 211.

[47] Exp. Sta. Haw. Sugar Planters' Assoc. Bull. **1** pt. 9 (1906) 319.

[48] Öfv. Vet.-Akad. Förh. **27** (1870) 734.

CICADELLA WHITEHEADII (Distant).

Tettigoniella whiteheadii DISTANT, Rhynch. Malayana, Rec. Ind. Mus. 11 pt. 1 (1908) 142–143; BAKER, Philip. Journ. Sci. § D 9 (1914) 418, fig. 9.

Female, length, about 11 millimeters.

Greenish pale ochraceous with fuscous venation. Tibiæ and tarsi fuscous; vertex with two black spots on apical margin; one black dot on each lateral margin, and one median angulated spot connected with a narrow black line to the base of the vertex; pronotum rounded in front and slightly concave, the lateral sides oblique, almost as long as broad, a longitudinal median black fascia attenuate on anterior third of pronotum; scutellum small with a longitudinal median fascia, anterior third almost indiscernible; a black margin on each upper claval area bordering commissural line down to tip of clavus; face strongly tumid, with a broad flattened front, lateral sides striated, striæ perpendicular to median parallel lines; tibiæ and tarsi fuscous.

LUZON, Laguna Province, Mount Banahao: Mountain Province, Benguet Subprovince, Mount Santo Tomas (*J. Valdez;* Osborn collection).

CICADELLA DIFFERENTIALIS Baker.

Cicadella differentialis BAKER, Philip. Journ. Sci. § D 9 (1914) 420.

Female, length, including tegmina, 7.5 millimeters.

Head, pronotum, and scutellum yellowish green. Vertex anteriorly convex, sordidly striated with light brown stria at apex; three black spots on disc, one on middle near base of vertex, and two on lateral margin near basal angle of face; pronotum with a semilunar dark green line on middle upper edge, and three fairly large square green spots on middle part; tegmina with pale fuscous veins; body beneath pale green with yellowish spots at places; legs pale ochraceous; lateral sides of last ventral segment notched, clipped, with middle slightly indented at center.

LUZON, Laguna Province, Los Baños, Mount Banahao: Rizal Province, Alabang (*J. Valdez*): Mountain Province, Baguio (Osborn collection).

CICADELLA BIPUNCTIFRONS Stål.

Cicadella bipunctifrons STÅL, Öfv. Vet.-Akad. Förh. 27 (1870) 733–734.

Female, length, including tegmina, about 8 millimeters.

Ochraceous. Vertex rounded, as long as half the distance between the eyes; foveate between eyes and ocelli; with two black

spots on apex of vertex equidistant from each other to eyes and above ocelli; two parallel brown fasciæ running longitudinally from apex down to clavus; frons broad and tumid, ochraceous, faintly striated with short perpendicular lines, one oblique brown marking on each lateral side; ocelli and eyes fuscous; face and clypeus ochraceous; pronotum transverse, basal and lateral sides rounded and margins truncate, four broad brown bands running longitudinally; scutellum triangular, acutely pointed at base, two central pronotal bands split on pronotum, dividing into four parallel longitudinal bands; clavus ochraceous with brown markings projected from head and notal regions, margined from claval suture by a red fascia which is one-third as wide as clavus; tip of tegmina transparent fuscous, rest of tegmina red with fuscous margin; wings fuscous, almost black; body and notal and abdominal dorsal region concolorous with wings; ventral side and legs yellowish ochraceous; last ventral segment with triangular-lobed sides and rounded central margin.

LUZON, Laguna Province, Los Baños (*S. S. Gonzales*), Mount Banahao. MINDANAO, Surigao (Osborn collection).

CICADELLA QUINQUENOTATA Stål.

Cicadella quinquenotata STÅL, Öfv. Vet.-Akad. Förh. 27 (1870) 734.
Kolla tripunctifrons BANKS, Philip. Journ. Sci. § D 5 (1910) 52, Palawan.

Length, including tegmina, about 9.25 millimeters.

Uniformly yellowish green. Vertex somewhat anteriorly produced, as long as wide between eyes, with discal black spots, two at apex, and two on margin in front of eyes; ocelli ochraceous-amber; eyes fuscous, with a distinct black spot on the lateral edge; face about one and one-half times as long as broad; frons swollen and somewhat flat on the middle, somewhat striate laterally; clypeus swollen and clearly separated by a suture; cheeks and lora pale pink; pronotum hexagonal, almost as long as broad with a curved transverse groove at anterior fourth, just back of the area of pronotal surface distinctly transversely wrinkled; scutellum small, somewhat wider than long; tegmina pale green to hyaline with brown venation.

One of the specimens has a faint spot on each lateral apex of vertex.

LUZON, Bataan Province, Mount Limay: Laguna Province, Mount Maquiling, Los Baños. MINDANAO, Zamboanga (Osborn collection).

CICADELLA ALTICOLA sp. nov.

Length, about 8 millimeters.

Greenish ferruginous. Vertex roundly produced, as long as one-half the width between eyes, greenish brown with a round black marking on apical center; one on each vertical edge, and two on the side below; ocelli equidistant from each other and eyes; margin between eyes and apical center occupied by deeply striated portions which are continuous on each side to margin of frons; frons tumid and flat, on the center marked with fuscous striæ; center greenish brown; cheeks and clypeus greenish ochraceous; pronotum transverse, base slightly rounded, about one-half as long as broad, anterior half with irregular black markings; scutellum triangular with acutely pointed marginal angle, slightly broader than long, third marginal portion with horizontal fovea, and a longitudinal median sulcus dividing it into two parts, each portion with an apical fuscous dot and a lateral broad fuscous stripe; tegmina long with five apical and three anteapical cells, with distinct brown venation, apex distinctly margined. Body underneath greenish ochraceous; legs light brown.

LUZON, Benguet Subprovince, Mount Santo Tomas, Haight's Place, and Mount Polis: Nueva Vizcaya Province, Imugan (type, Osborn collection).

CICADELLA SUTURELLA (Stål).

Tettigonia suturella STÅL, Öfv. Vet.-Akad. Förh. 5 (1855) 192.

Length to tip of tegmina, 5.5 millimeters.

Vertex short, a little longer than one-half length of pronotum, with bluntly rounded apex, amber yellow, two black spots, one in each angle equidistant between the eye and the anterior portion, one on disc and two black spots surrounding the amber-colored ocelli; frons amber yellow with an elongated black spot on upper portion, disc distinctly foveate and marked on the sides by yellow striæ, lora and gena ochraceous; pronotum light yellow with two oblique lines from basal inner third to posterior base, forming an obtuse angle; scutellum amber orange, a transverse line on the middle, with two broken parallel black lines laterally, the continuation of pronotal lines on edges of tegmina forming the commissural lines; tegmina hyaline, with milky white venation, the borders of which are black and fuscous. Body underneath and legs pale yellow; last ventral segment truncate in male, slightly convex in female.

LUZON, Laguna Province, Paete, Los Baños, and Pansol. NEGROS, Occidental Negros Province, Dumaguete. MINDANAO, Zamboanga.

Known host *Acalypha* sp., evidently widely distributed in the Philippines.

CICADELLA NIGRIFASCIATA sp. nov.

Male, length, including tegmina, 5.5 millimeters.

This species has morphological characteristics similar to those of *C. suturella* Stål, of about the same size and general appearance. The marking of this species is more accentuated. There are more spots and markings on the vertex. The notal markings are consolidated into a semicircle, in contradistinction to those of *C. suturella,* which are oblique, meeting at an angle. In males frons and clypeus entirely black, in some there is a black fascia on the middle of the frons and on the lateral margins of the frons and cheeks; fasciæ of frons connected by transverse striæ; scutellum with a longitudinal black marking near each lateral angle and confluent with the commissural black lines terminating at the tip of tegmina. Entire lateral margins of tegmina bordered by a black marking. Thoracic and abdominal sclerites marked partially with black at the middle, with the exception of the genital plates, which are ochraceous. The vertex is rounded, about one-third as long as the distance between the eyes; pronotum transverse, slightly wider than long, basal margin rounded, the lateral sides oblique, and posterior almost truncate; scutellum triangular, posterior half separated by an impressed line; body beneath the wings black; legs stramineous.

This species is abundant on cotton in the Philippines.

LUZON, Mountain Province, Mount Santo Tomas (type), Balbalan and Baguio (paratype, Osborn collection).

Genus MILEEWA Distant

Mileewa DISTANT, Fauna Brit. Ind. Rhynch. 4 (1908) 238; BAKER, Philip. Journ. Sci. § D 9 (1914) 415.

Type, *M. margheritæ* Distant.

According to Distant [49] this genus is known only from Assam. Baker [50] described a new species and a new variety of this species from Mount Maquiling, Luzon, and named the species *M. luzonica.*

[49] Fauna Brit. Ind. Rhynch. 4 (1908) 238.
[50] Philip. Journ. Sci. § D 9 (1914) 415–416.

MILEEWA LUZONICA Baker.

Mileewa luzonica BAKER, Philip. Journ. Sci. § D 9 (1914) 415–416.

Vertex, pronotum and scutellum ferruginous, the front margin of vertex and all below very pale yellowish, the tegmina washed with a shining ferruginous. A large rectangular spot in middle of vertex, 2 round spots near basal margin of pronotum, a varying and indistinct median area on posterior half of pronotum, lateral angles of scutellum broadly, a narrow longitudinal band on clavus within commissural margin and not reaching tip of clavus, a longitudinal band on corium bordering claval suture and passing into inner apical cell, and a band from base of tegmina passing to apex of first anteapical cell, black; area of apical cells smoky translucent. Length ♂ 4.5, ♀ 4.75 mm.

Length of face two and one-fourth times width between eyes, basal clypeal suture distinct, the whole surface faintly shagreened; front and clypeus strongly convex, the former slightly flattened on disc above. Length of vertex about three-fourths of width between eyes, surface smoothly convex. Ocelli nearly on line of anterior margin of eyes, somewhat nearer to eyes than to each other. Pronotum smooth, the pleural carina very fine but complete. Scutellum wider than long, a fine impressed transverse line at middle. Tegmina opaque proximad of apical cells, but not all coriaceous and not at all punctate. If viewed squarely the hind margin of last ventral segment appears to be slightly incurved and with a median projection, the hind angles oblique; if viewed at a slight angle the hind margin appears to be deeply emarginate.—BAKER, loc. cit.

My specimens were all collected near Los Baños, at the foot of Mount Maquiling. The color of the vertex, pronotum, and scutellum is orange and not ferruginous; the tegmina is of the same color, except the clavus which is greenish yellow; the ocelli are equidistant from each other and from the eyes; and the scutellum is equilateral. The rest of the characters conform to Baker's description of the insect. In the Osborn collection there is a specimen collected at Subaan, Mindoro, and another collected at Haight's Place, northern Luzon. The latter specimen is pale, slightly larger than the rest, and the pronotal markings are quite indiscernible.

Genus MAKILINGIA Baker

Makilingia BAKER, Philip. Journ. Sci. § D 9 (1914) 409–410; 24 (1924) 57–58.

Type, *M. nigra* Baker.

This genus was erected by Baker [51] for a group of small Tettigoniellinæ colored principally black and red, rarely whitish, collected on Mount Maquiling and Mount Banahao, which later on

[51] Tom. cit. 410–411.

Baker[52] believed should belong to the subfamily Gyponinæ instead. It is, however, my opinion that *Makilingia* species, having unique characteristics which warrant placing them under a separate genus, are more closely related to the Tettigoniellinæ than to the Gyponinæ, for the following reasons:

The general shape of the head and the body of *Makilingia* appear more like those of *Kolla* of the Tettigoniellinæ than like those of *Bhooria* of the Gyponinæ. It is true that *Bhooria* has a considerable affinity to the Tettigoniellinæ, but due to the structure of the face, Distant[53] thought it wise to locate it with the Gyponinæ. It is these peculiar characteristics of the face that separate *Makilingia* from *Bhooria*. The vertex of *Makilingia* is slightly longer than broad, similar to the vertex of *Kolla*, while that of *Bhooria* is much longer than broad, prominently acutely narrowed. It is even as rounded in front as *Bhandara*, of the Tettigoniellinæ. *Kolla* is a Tettigoniellini, closely allied to *Tettigoniella*, but differing by the structure of the vertex, which is subconically narrowed anteriorly and which is also more or less foveate, characteristics of most of the species of *Makilingia*. Again the vertex of *Bhooria* has a central longitudinal ridge, while that of *Makilingia* is sulcate.

In the arrangement and venation of the tegmina *Makilingia* is nearer to *Tettigoniella* than to any other genus. The folding of the anterior wings and the four apical cells and two or three anteapical cells are also found in the Tettigoniellinæ.

The elongated and gradually tapering clypeal sclerite is more that of a *Tettigoniella* than of a *Gypona*. It is certainly closer to *Tettigoniella whiteheadii* Distant (Baker[54]) than to *Bhooria modulata* Distant.[55] The absence of the frontoclypeal suture coupled with the exaltation of the lateral vertical angles over the eyes are the unique and distinguishing characteristics of this genus. The absence of the frontoclypeal suture denotes antiquity of the group. This suture is, however, present in an indiscernible condition in the species *M. pruinosa* Baker which shows the direct line from *Makilingia* to *Tettigoniella* or *Cicadella*. The clypeal structure is more specialized in the Gyponinæ. In *Tettigoniella longa* and allied species, such as *Cicadella philippina* Walker, the clypeal sutures are quite indiscernible. I be-

[52] Idem 24 (1924) 57.
[53] Fauna Brit. Ind. Rhynch. 4 (1908) 256.
[54] Philip. Journ. Sci. § D 9 (1914) 412–419.
[55] Fauna Brit. Ind. Rhynch. 4 (1908) 256–257.

lieve that *Makilingia* is an older group with *Tettigoniella* as an intermediate group between it and *Gypona.*

Five species were described in 1914. In 1924 Baker[56] described ten more species which were collected not only from the mountains of northern Luzon but also from the lowlands and from other islands. However, he believed that this genus is confined to the Philippine Islands.

Small tettigoniellids, colored principally black and red, rarely whitish, with head much narrower than pronotum, anterior margin very shortly sublaminate and strongly rounded in front between the eyes. Face rather long and narrow. Basal clypeal suture usually entirely obsolete. Loræ small and narrow. Lateral frontal margins passing close to eyes. Vertex flattish or concave, variously impressed or excavated, and always longer than half width between eyes. Ocelli placed before the line of anterior margins of eyes. Pronotum longer than the vertex, of a sexangular type in form, but anteriorly strongly, quite evenly, and narrowly rounded from the lateral angles to between the eyes, the posterior lateral margins short, the posterior margin gently incurved, the pleural area with a strong complete carina. Scutellum usually large, longer than wide or wider than long, and with an acuminate tip, the posterior area more or less swollen. Tegmina normal in outline or somewhat narrowed distad, with four apical cells and 2 or 3 anteapicals, sometimes with indistinct and irregular cross-veins in the costal area; clavus without cross-veins, its 2 sectors joining the commissure; appendix very short or extending to near tip of inner apical cell. Armature of hind tibia dense and heavy. Sculpturation largely a heavy and conspicuous puncturation.—BAKER, Philip. Journ. Sci. § D 9 (1914) 409–410.

MAKILINGIA NIGRA Baker.

Makilingia nigra BAKER, Philip. Journ. Sci. § D 9 (1914) 411, fig. 1; 24 (1924) 68–69.

This species has all the appearance of a *Kolla.*

Body and tegmina deep black, the legs and two basal antennal articles lemon yellow. Length ♂ 5, ♀ 6 mm.

Length of face twice the width between eyes; basal clypeal suture obsolete; front a little swollen and with disc flattened, transversely impressed above, beneath margin of vertex; front coarsely sparsely punctate on disc, lateral margins and clypeus coarsely shagreened; loræ and genæ with very large confluent punctures. Length of vertex about five-sixths of the width between eyes, its anterior lateral margins slightly bisinuate; surface coarsely sparsely punctate, the entire lateral areas between ocelli and eyes deeply excavated, as is also the anterior median area. Ocelli somewhat in front of anterior line of eyes, and about as far from each other as from eyes. Pronotum coarsely sparsely punctate, and posteriorly with indistinct transverse rugæ. Scutellum wider than long; longer than pronotum,

[56] Philip. Journ. Sci. 24 (1924) 57–71.

transverse impressed line at middle very strong and medially widened; posterior to impressed line the surface is distinctly longitudinally striolate. Tegmina opaque, coriaceous proximad including the clavus, the entire coriaceous portion strongly sparsely punctate. Last ventral segment of female rectangularly emarginate, the lateral posterior borders strongly curved.—BAKER, Philip. Journ. Sci. § D 9 (1914) 411.

LUZON, Laguna Province, Mount Banahao and Mount Maquiling (type, Baker collection); Batangas Province, Santo Tomas (Osborn collection). NEGROS, Cuernos Mountain. PANAY. MINDANAO, Surigao Province, Surigao. BASILAN.

MAKILINGIA TETTIGONOIDES Baker.

Makilingia tettigonoides BAKER, Philip. Journ. Sci. 24 (1924) 60–61.

Female, length, 8 millimeters. Ochraceous to yellowish; abdomen black with pale segmental margins; tegmina, except costal margins greenish to near apical cross veins, the apices slightly smoky; vertex with four black spots, two marginal near apex, and two surrounding ocelli; on infero-posterior surfaces of eyes, beneath posterior margin of vertex and entirely hidden from view without separating the head from pronotum, are two black spots; pronotum with two black spots just behind eyes; large black spots also occur on basal angles of scutellum; basal lateral angles of front narrowly black.

Front strongly convex, medially shallowly depressed, very faintly shagreened, smooth, shining. Clypeus strongly roundly umbonate basally, with surface like that of front. Genæ and loræ with shallow separated punctures. Vertex strongly depressed before the sharp anterior margin, as usual in this genus, the remainder of surface separated into three portions by low rounded longitudinal prominences along the lines of the ocelli, the lateral concavities much the deeper; the median area minutely and sparsely punctured, the lateral areas wrinkled next eyes. Ocelli large, equidistant from basal and antero-lateral margins of vertex and nearer to eyes than to each other. Pronotum uniformly covered with separated punctures, the interspaces smooth, and transverse rugæ not evident. Tegminal punctures well separated, the interspaces smooth. Genital segment apically broadly, deeply, arcuately emarginate.

Male, length, 7.5 millimeters. Vertex more broadly rounded apically. Color inclining to testaceous (as is sometimes the case in females). Meso- and metasternal sclerites black. Spots of vertex enlarged and variously coalesced. A common type is represented in males from Baguio, though many minor variations of this occur. A male color form from Dapitan shows complete coalescence of the black spots across disk of vertex. Females occasionally have the male type of marking, and one Baguio female is selected which is similar to Dapitan males. The vertex is finely wrinkled anteriorly also, and has two small deep depressions near basal margin. Genital segment as long as broad, roundly swollen, shining black, hind margin nearly truncate except for a short, acute, median projection; base of the long slender plates very broad, undivided, and swollen.—BAKER, loc. cit.

LUZON, Benguet Subprovince, Baguio and Pauai (Haight's Place): Nueva Vizcaya Province, Imugan. MINDANAO, Zamboanga Province, Dapitan (*Baker*).

According to drawings presented by Baker [57] for this species there are four characteristic groups of markings (Plate 1, fig. 1, *a*). Head ochraceous, vertex with four black spots, two marginal near apex, and two surrounding the ocelli. This variety, according to specimens collected on Mount Polis, Luzon, is light yellow or ochraceous, with two anterior pronotal and two anterior angular markings; two anterior tegminal black markings and two apical vertex markings are confluent with the two marginal apices; the entire face is amber yellow. The variety represented by Plate 1, fig. 1, *b*, head black, and the one with four antero- and three posterovertical yellow markings, two anterior black spots on pronotum and two very conspicuous anterior angular black spots of the scutellum, has entirely black face and the general color of the tegmina is greenish ochraceous. The other, represented by Plate 1, fig. 1, *c*, has head black, vertex with two semitransverse and three posteromarginal ochraceous markings, and two more or less rectangular pronotal black markings just below the eyes, and the upper half of the scutellum black; the frons black, the clypeus castaneous brown; cheeks ochraceous.

Female, 8 millimeters, and male, 7.5, four specimens, three males, two from Mount Polis and one from Baltaiason, Luzon, and one female from Mount Polis, northern Luzon, are available for study. These specimens are uniformly ochraceous and the markings are also uniform. They all conform to Plate 1, fig. 1, *a* (Osborn collection).

One female and one male collected at Santo Tomas, Batangas Province, near Mount Maquiling, also conform to Baker's Plate 1, fig. 1, *b*. These specimens are ochraceous, slightly darker than the above variety.

The markings of the female differ slightly from those in Plate 1, fig. 1, *b*, of Baker, as there is on this specimen a distinct dot on each lateral angle of the vertex just above the anterior edge of the eyes. Also the two ochraceous spots above the ocelli are larger and more confluent. In the male these two spots are enlarged with a projection directed towards the apex of the vertex, and the black markings on the anterior and on the poste-

[57] Philip. Journ. Sci. 24 (1924) 60–61, pl. 1, fig. 1 *a–d*.

rior sides of the vertex coalesced, just above the inner margins of the eyes.

In specimen *c*, collected at Santo Tomas, Batangas Province, Luzon, the marking on the apical margin of the vertex is cut by two vertical ochraceous lines, so that it appears as three black spots on the apical end. The black markings on the lateral angles of the vertex just above the inner margins of the eyes are almost indiscernible and are not united with the posterior markings. The scutellar spots have coalesced into a band or fascia occupying the anterior portion of the scutellum.

In specimen *d*, collected on Mount Polis, Mountain Province, Luzon, the two anterior markings are separated from the posterior median markings surrounding the ocelli. The anterior pronotal spots as appearing on all of the varietal forms are reduced. All other markings mentioned are also reduced.

There seem to be no definite markings on the vertex, pronotum, or scutellum in this species (*M. tettigonoides*).

All specimens studied are from the Osborn collection.

MAKILINGIA SPECIOSA Baker.

Makilingia speciosa BAKER, Philip. Journ. Sci. 24 (1924) 61–62, pl. 1, fig. 2, *a–f*.

A single specimen collected at Santo Tomas, Batangas Province, Luzon (Osborn collection) is perhaps the largest of the group. It is a female about 10 millimeters long. It is tricolored above, black from head to tip of scutellum, and the area parallel to the costal margin, one-fourth the distance to the base of the tegmina; the following one-eighth is reddish and the rest pale brown; lateral margin of the cheeks, and anterior margin of vertex, and the posterior margin of pronotum as well as the legs and venter are pale brown. Baker states that his specimens, taken in Benguet, Mountain Province, were only four. Although it is the most conspicuous, it is a rare species, he considers.

MAKILINGIA INTERMEDIA Melichar.

Makilingia intermedia MELICHAR, Wiener Ent. Ztg. 40 (1923) 119.
Makilingia variabilis BAKER, Philip. Journ. Sci. 24 (1924) 63–64, pl. 1, figs. 4, 5.

This lone male specimen, 4.75 millimeters long, is the smallest *Makilingia* in the collection. Melichar is credited with having named the species before Baker.[58]

Makilingia intermedia is black with four equidistant brown spots on the extreme anterior part of the vertex; eyes and ocelli

[58] Idem 27 (1925) 159.

brown; tegmina with a cup-shaped yellow marking at the middle of the clavus, the posterior part or tip of clavus yellow, one yellow dot on the middle margin of corium near the claval suture; base of antennæ and legs yellow; scutellum small, broader than long. Originally described from Trinidad, Mountain Province, Luzon.

LUZON, Mountain Province, Balbalan (Osborn collection).

MAKILINGIA INTERMEDIA Melichar var. SIMILLIMA Baker.

Makilingia intermedia Melichar var. *simillima* BAKER, Philip. Journ. Sci. 24 (1924) 63–64.

One female and two males were collected on Mount Polis, northern Luzon (Osborn collection). The female is 5.25 millimeters long and the males about 5.

This variety is somewhat larger than the species *intermedia* Melichar. The tegminal markings are continued on the commissural line, with complete absence of the spot on the corium, the vertex having two marginal spots in the female and none in the male. Other coloration is the same as that of *intermedia* Melichar.

LUZON, Mountain Province, Mount Polis and Baguio: Nueva Vizcaya Province, Imugan. MINDANAO, Zamboanga Province, Dapitan (*Baker*).

MAKILINGIA BANAHAOENSIS Baker.

Makilingia banahaoensis BAKER, Philip. Journ. Sci. 24 (1924) 64–65, pl. 2, figs. 6, 7.

Two males, about 5 millimeters long, one of the variety *montalbanensis*.

Black; vertex with two small reddish apical spots and two large lateral spots. In variety *montalbanensis* each of these lateral spots coalesces with one of the apical spots, forming two lateral bands; clavus with a yellow spot on each lateral angle, claval area from the area adjoining the posterior angle of the scutellum to the tip where commissural line and the claval suture meet yellow; legs and base of antennæ reddish yellow. Dorsal side of insect coarsely punctured.

MINDORO, Saban (Osborn collection).

Previously reported by Baker from Mount Banahao, Laguna Province, and Montalban, Rizal Province, both in Luzon.

MAKILINGIA HAIGHTIANA Baker.

Makilingia haightiana BAKER, Philip. Journ. Sci. 24 (1924) 65.

Female, length, about 8 millimeters.

Black, vertex with two large reddish lateral and one median apical spot, about one and one-fourth as long as the breadth

between the eyes; pronotum and scutellum jet black, coarsely punctured and striated; tegmina black, clavus margined both at commissural line and claval suture; corium and costal margins with ochraceous bands; tip of tegmina cloudy hyaline with fuscous margin; frons with a reddish spot, venter black; legs ochraceous.

LUZON, Benguet Subprovince, Haight's Place (Osborn collection).

MAKILINGIA LINEATA Baker.

Makilingia lineata BAKER, Philip. Journ. Sci. 24 (1924) 65–66, pl. 2, fig. 9.

Female, length, 6 millimeters.

Black; vertex obtusely produced with two large reddish lateral spots occupying two-thirds of the lateral margins; eyes and ocelli orange; tegmina black, coarsely punctured, with reddish commissural lines, with anchorlike curve on upper one-third of the clavus; tip of tegmina smoothly fuscous; legs and the base of the antennæ reddish ochraceous.

LUZON, Nueva Vizcaya Province, Imugan (*Baker*): Benguet Subprovince, Mount Polis (Osborn collection).

MAKILINGIA FLAVIFRONS Melichar.

Makilingia flavifrons MELICHAR, Wiener Ent. Ztg. 40 (1923) 119.
Makilingia bimaculata BAKER, Philip. Journ. Sci. 24 (1924) 67, pl. 2, fig. 12.

Male, length, about 7.5 millimeters.

Black; vertex subacutely pointed with large yellow lateral spots; pronotum, scutellum, and tegmina, except the tips, black, coarsely punctured all over, eyes and whole front yellow, legs yellow; venter yellow with median black markings.

LUZON, Benguet Subprovince, Baguio; Ifugao Subprovince, Mount Polis (Osborn collection): Nueva Vizcaya Province, Imugan. MINDANAO, Zamboanga Province, Dapitan (*Baker*).

MAKILINGIA PALLIDA Baker.

Makilingia pallida BAKER, Philip. Journ. Sci. § D 9 (1914) 414–415, fig. 5; 24 (1924) 68.

Female, length, about 5 millimeters.

Body pale ochraceous; tegmina milky white with smoky brown margins at the tip; vertex rounded, about as long as the breadth between the eyes; two-thirds of lateral sides sulcate; eyes and ocelli ochraceous to fuscous, ocelli surrounded by a black margin; two black spots, one on each posterior angle of vertex, next to eyes; vertex, pronotum, scutellum, and anterior half of tegmina

sparsely punctured and the apical half smooth and somewhat transparent. Crown almost flat and square; frons almost rectangular and about twice as long as the breadth between the eyes. Last ventral segment sinuate at posterior middle and with black markings.

LUZON, Laguna Province, Mount Maquiling (type), Los Baños: Tayabas Province, Malinao: Benguet Subprovince, Baguio (var. *benguetensis* (Baker collection).

MAKILINGIA MACULATA Baker.

Makilingia maculata BAKER, Philip. Journ. Sci. § D 9 (1914) 412–413, fig. 3; 24 (1924) 62.

Female, length, about 5.75 millimeters.

Black; vertex somewhat triangular, somewhat pointed, about two-thirds as long as breadth between eyes, shallowly concave, with four yellow markings on lateral margins; eyes and ocelli fuscous, frons twice as long as breadth between eyess, clypeal suture obsolete; pronotum distinctly rounded in front, transverse coarsely and sparsely punctured, posterior margin almost truncate; humeral angles pointed; scutellum small, nearly smooth; tegmina black and coarsely punctured, posterior two-thirds of lateral sides of clavus margined with greenish yellow markings, center costal margin ochraceous, tip of tegmina fuscous; legs and base of antennæ yellow, body black beneath.

LUZON, Batangas Province, Santo Tomas (Osborn collection): Laguna Province, Mount Banahao, Mount Maquiling, and Los Baños: Tayabas Province, Malinao. MINDORO, Surigao Province, Surigao: Zamboanga. BASILAN and SIBUYAN (Baker collection).

MAKILINGIA PRUINOSA Baker.

Makilingia pruinosa BAKER, Philip. Journ. Sci. § D 9 (1914) 412; 24 (1924) 68.

Length, about 6.5 millimeters.

Long and slender, tegmina narrow and overlapped at tips. Black, except legs, base of antennæ, and eyes, which are brown to fuscous. Vertex slightly produced, pointed, with four yellow markings, two at the apex and two on lateral sides adjoining eyes; frons coarsely striated; frons to clypeal suture distinctly visible; pronotum anteriorly rounded, lateral angles pointed, posterior margin sinuate, coarsely and sparsely punctured; scutellum very small; tegmina sparsely punctured, apices of clavus and corium fuscous.

LUZON, Batangas Province, Santo Tomas (Osborn collection): Laguna Province, Mount Maquiling, Mount Banahao: Mountain

Province, Baguio: Nueva Vizcaya Province, Imugan. MINDANAO, Zamboanga Province, Dapitan (Baker collection).

MAKILINGIA COLORATA Baker.

Makilingia colorata BAKER, Philip. Journ. Sci. § D 9 (1914) 412–413, fig. 3; 24 (1924) 62.

Female, length, about 5.5 millimeters.

Vertex with six coalescing reddish yellow spots forming a marginal border from the posterior margin to two-thirds side of vertex, and one similar spot on middle of posterior margin; anterior side of face with yellow marginal stripe; base of antennæ yellow; frons and clypeus black, suture between them obsolete, together they are about three times as long as space between the underpart of eyes; rostrum and femora pale ochraceous, front femora with three black markings, tibia reddish; prosternal and metasternal episternum black. Venter ochraceous, the last ventral segment deeply sinuated, middle part black; tegmina reddish brown.

LUZON, Laguna Province, Los Baños (Merino collection): Tayabas Province, Malinao: Mountain Province, Haight's Place. NEGROS, Occidental Negros Province, Cuernos de Negros. MINDANAO, Agusan Province, Butuan: Surigao Province, Dapa (Osborn collection).

GYPONINÆ

Ocelli on the disc as in the Tettigoniellinæ, but the face flat or slightly convex, and the body decidedly flattened dorsoventrally.

There are two divisions of cicadellids in this subfamily: Penthimiaria, with a short vertex, considerably broader than long, transversely rounded anteriorly, and not produced; and Hylicaria, with the vertex not broader than long, and more or less angularly produced.

According to this arrangement the genus *Thaumatoscopus* Kirkaldy, represented by a new species, *roxasi,* herein described, fits very well in the division Penthimiaria with the other two species studied, *Penthimia hemifuscata* sp. nov. and *Neordatus acocephaloides* Melichar.

Key to the genera of the division Penthimiaria.

a [1]. Scutellum longer than vertex, its basal margin considerably longer than lateral margin.

b [1]. Length of vertex equal to about one-half breadth between eyes, short, transverse, anteriorly convexly rounded and depressed. *Penthimia* Germar.

b [2]. Length of vertex equal to about two-thirds breadth between eyes, subelongate, anteriorly obliquely rounded and reflexed.
Neodartus Melichar.

a [2]. Scutellum shorter than the vertex, its basal margin only slightly longer than the lateral margin................................ *Thaumatoscopus* Kirkaldy.

Genus PENTHIMIA Germar

Penthimia GERMAR, Mag. Ent. 4 (1821) 46; STÅL, Hem. Afr. 4 (1866) 107; FIEBER, Rev. Mag. Zool. 3 (1875) 392; ATKINSON, Journ. As. Soc. Bengal 54 (1885) 112; VAN DUZEE, Trans. Am. Ent. Soc. 21 (1894) 287; MELICHAR, Hom. Fauna Ceylon (1903) 161; DISTANT, Fauna Brit. Ind. Rhynch. 4 (1908) 241.

Type, *P. atra* Fabricius, a Palæarctic species.

Distribution: Nearctic, Palæarctic, Ethiopian, Oriental, and Australian Regions.

Body ovate, compact; head short, broad, narrower than pronotum, rounded anteriorly; vertex sloping anteriorly, equal to one-half the breadth between eyes; pronotum large, transverse, and faintly, transversely striated, sloping towards the front, rounded anteriorly; tegmina short with enlarged appendix, inclined posteriorly from the truncated apex of clavus, femora compressed posteriorly and hind tibia strongly spinose.

PENTHIMIA HEMIFUSCATA sp. nov.

Length, 5 millimeters.

Vertex ochraceous, profusely spotted with fuscous markings; pronotum transverse, ochraceous; vertex broader than long; ochraceous with fuscous markings, an impressed line on the anterior half; upper half of tegmina ochraceous, sparsely spotted with fuscous markings at the humeral angle, posterior half profusely spotted with fuscous markings, apex ochraceous with exception of inner apical cell and appendix which are partially and horizontally marked with short fuscous lines; face black; hind legs black, tibial spurs ochraceous; pectus, venter, and legs fuscous with ochraceous markings.

LUZON, Mountain Province, Mount Santo Tomas (type, Osborn collection).

Genus NEODARTUS Melichar

Neodartus MELICHAR, Hom. Fauna Ceylon (1903) 162.

Type, *N. acocephaloides* Melichar.

Distribution: Oriental Region.

Vertex about two-thirds as long as the breadth between the eyes, broad, obtuse, slightly sloping towards the front, the apex being slightly reflexed; ocelli nearer to the eyes than to each other; pronotum transverse, anterior margin strongly rounded,

posterior broadly concave, almost truncate; scutellum transverse; tegmina broad and short, posteriorly inclined from truncated apex of clavus. The appendix is well developed, as in *Penthimia*, to which this genus is most closely allied.

NEODARTUS ACOCEPHALOIDES Melichar.

Neodartus acocephaloides MELICHAR, Hom. Fauna Ceylon (1903) 163; DISTANT, Fauna Brit. Ind. Rhynch. 4 (1908) 246, fig. 155.

The characteristics of the specimen at hand more or less tally with Distant's description,[59] which has been changed here to fit more accurately the Philippine specimen.

Length, including tegmina, 4 millimeters.

Vertex, pronotum, and scutellum black; pronotum margined exteriorly with faint white stripe, scutellum with two white spots on each lateral side and one on the middle of the anterior margin; tegmina black, with thick ochraceous spots, the apex smoky gray where the veins are fuscous and preceded by an irregular transverse series of four white spots, clavus with a series of four irregular spots and middle of costal region with a large white spot; femora and pectus black, tibia and venter paler, spotted with black; pronotum finely, transversely wrinkled, scutellum very finely, transversely striate, a transverse impression before apical area, anterior middle third with pubescence, apical margin of clavus distinctly incrassate; posterior tibia strongly spinulose, the spines ochraceous.

Hitherto known only in the Punjab, Calcutta, Ceylon, Peradeniya, Negombo.

LUZON, Benguet Subprovince, Mount Santo Tomas (Osborn collection). The species is here reported for the first time from the Philippines.

Genus THAUMATOSCOPUS Kirkaldy

Thaumatoscopus KIRKALDY, Exp. Sta. Haw. Sugar Planters' Assoc. Bull. 1 pt. 9 (1906) 422.

Type, *T. galeatus* Kirkaldy, an Australian species.

This genus is closely related to *Penthimia*. The head is more produced and the vertex has a thin border anteriorly; ocelli small, discal just above anterior margin of eyes; pronotum transverse, shorter than vertex or scutellum; vertex roughly shagreened; pronotum and scutellum coarsely striate; tegmina short and broad; scutellum apically truncate, just as in *Penthimia* and *Neodartus*.

[59] Fauna Brit. Ind. Rhynch. 4 (1908) 246.

Kirkaldy [60] erected this genus for a species collected in Queensland, Australia, by Koebele and Perkins (1904 or 1905).

THAUMATOSCOPUS ROXASI sp. nov.

Male, length, including tegmina, 7 millimeters; width, 3.

Fuscous above, piceous below. The face below and the prosternum and mesosternum piceous; the hind legs fuscous; vertex slightly convex, roundly produced, one and one-half times as long as broad, greatly depressed, margined by a narrow brown band, rim slightly produced above the upper margin of eyes, middle rufous from base to two-thirds the distance from middle to the eyes, and ascending upward protruding towards the median line; eyes almost piceous, fuscous in female; upper half of face inflexed and flat, piceous, gena separated from lora by a ridge; clypeus small, almost oblong; frons greatly depressed, upper fourth narrow; cheeks broad, foliaceous, thinly produced; pronotum transverse, anterior and lateral sides rounded, oblique; lateral sides truncate, posterior side distinctly concave, rounded dorsally, greatly inclined anteriorly; scutellum small, slightly broader than long, transversely divided by a suture on the middle, this being the highest level so that the insect has a humped appearance; tegmina broad, rounded at the apex, areoles with lighter color, wing veins in male piceous above and fuscous at the ends; ends, vertex, pronotum, scutellum, and tegmina roughly and coarsely shagreened; hind legs extraordinarily developed, depressed, armed with large spurs. The flat and rounded shape, the foliaceous vertex curved downward, the impressed mouth parts, and the dark coloration seem to indicate that this insect is a ground type. It is possible that this species feeds on roots of plants, but our specimen was collected from shrubbery.

LUZON, Rizal Province, Alabang (type in my collection).

I am naming this peculiar and uncommon insect for Dr. Manuel L. Roxas, former director of the Bureau of Plant Industry and former under secretary of the Philippine Department of Agriculture and Commerce, in appreciation of his great interest in entomological development for the benefit of agriculture.

THAUMATOSCOPUS REFLEXUS Stål.

Penthimia reflexa STÅL, Öfv. Vet.-Akad. Förh. 27 (1870) 738.

Female, about 8.5 millimeters.

Species lighter and slightly larger than *roxasi*. Ferruginous all over except the face, prosternum, and mesosternum, which

[60] Exp. Sta. Haw. Sugar Planters' Assoc. Bull. 1 pt. 9 (1906) 422.

are black; hind femora and tibia fuscous, vertex foliaceous, rounded, slightly longer than width between eyes, apex slightly reflexed, lateral edges above line of eyes; ocelli quite inconspicuous, on middle of vertex; eyes relatively small; pronotum transverse, distinctly hexagonal, shorter than vertex, anterior side rounded, posterior concave, lateral sides parallel, posterior angles truncate, finely, transversely striated; scutellum slightly broader than long; tegmina coriaceous, small portion of posterior part somewhat transparent, wing veins fuscous.

Stål does not give the distribution of this insect. The type was a Philippine specimen.

LUZON, Manila (*J. Valdez*).

JASSINÆ (including ACOCEPHALINÆ)

The Acocephalinæ are regarded as a distinct subfamily by many authors, as a separate family by some, and as merely a tribe or even a genus by others.

The reason for this simplification or union of the two subfamilies is the difficulty of separating them on the basis of the location of the ocelli. Distant [61] said that *Xestocephalus,* placed by Van Duzee, its founder, in the Acocephalinæ, is placed by Melichar and Matsumura in the Jassinæ. *Hecalus,* which is included by Stål, its founder, in the Acocephalinæ, is considered a member of the Jassinæ by Van Duzee. The main distinguishing feature of the two is as follows:

Ocelli placed superiorly close to the anterior edge of the head. *Acocephalinæ.*
Ocelli on the anterior edge of the head or wanting .... *Jassinæ.*

Distant included the genera belonging to the Acocephalinæ in his synopsis of the Jassinæ. The following is a tentative key for the groups or divisions of the Jassinæ-Acocephalinæ based on characteristics given by Distant:

Key to the divisions of the Jassinæ and the Acocephalinæ.

a^1. Face not strongly impressed across base.
  b^1. Body depressed, vertex flatly produced .... *Hecalusaria.*
  b^2. Body not depressed.
    c^1. Vertex produced beyond eyes; lateral margins of vertex not ridged, obliquely narrowed basally at inner margins .... *Jassusaria.*
    c^2. Vertex shorter than breadth between eyes, not produced, one-half as long as breadth between eyes, rounded anteriorly. *Selenocephalaria.*
    c^3. Vertex about, or more than three times as long as distance between eyes .... *Tartessusaria.*

[61] Fauna Brit. Ind. Rhynch. 4 (1908) 265–266.

c^4. Vertex one-half or less than one-half as long as distance between eyes; lateral margins not so narrowed.
d^1. Anterior margin of vertex roundly produced, wider than long at middle .... *Cicadularia.*
d^2. Anterior margin acutely or subacutely produced; face longer than broad at base........ *Thamnotettixaria.*
c^5. Vertex more or less angularly produced in front of eyes; face not longer than broad at base........ *Athysanusaria.*
c^6. Vertex as long as or longer than breadth between eyes; tegmina usually covering dorsum of abdomen........ *Deltocephalusaria.*

Division HECALUSARIA

The general characteristics for this division are the depressed body, the more or less flatly produced vertex, and the placement of the ocelli on the apical margin of the vertex near the eyes. The following key to the genera is from Distant's synopsis of the division: [62]

Key to the Philippine genera of the division Hecalusaria.

a^1. Vertex not prominently angulate in front.
b^1. Tegmina with five apical cells........ *Hecalus* Stål.
b^2. Tegmina with about six posterior discoidal areolets or cells. *Thomsoniella* Signoret.
a^2. Vertex twice as long as pronotum; face about three times the length of clypeus, tegmina with four apical cells, lateral margins of face convex .... *Nirvana* Kirkaldy.

Genus HECALUS Stål

Hecalus Stål, Ann. Soc. Ent. Fr. (1864) 65.
Glossocratus Fieber, Verh. Zool.-Bot. Ges. Wien 16 (1866) 502.

Type, *H. paykulli* Stål.

Distribution: Neartic, Oriental, Australasian, and Ethiopian Regions. (Probably widely distributed.)

Body oblong or elongate, depressed; head somewhat so, produced apical margin acute, more or less broadly foliaceous; front dilated, somewhat deeply sinuate below the eyes; face a little convex; eyes small or moderate; ocelli placed on the apical margin of the head at or near the eyes; pronotum transverse, very obtusely rounded at apex; scutellum triangular, a little broader than long; tegmina almost as long as abdomen, margined at apex, valvate behind the clavus, with five apical cells; legs moderate; posterior tibiæ very spinose.—Stål, cited by Distant, Fauna Brit. Ind. Rhynch. 4 (1908) 273–274.

HECALUS GRAMINEUS sp. nov.

Length, including tegmina, 7 millimeters.

Grass green all over. Vertex about as long as breadth between eyes, or slightly longer; margined by two reddish brown

[62] Tom. cit. 273.

lines, one passing just above the edge and the other below, both crossing eyes longitudinally; eyes ochraceous with two longitudinal red lines; ocelli ochraceous, located on edge of vertex, just above eyes; face tumid, cheeks slightly inflexed just below eyes; pronotum transverse, about twice as broad as long, anterior margin slightly rounded, posterior slightly concave, lateral sides parallel; scutellum about one and one-half times as broad as long, an almost indiscernible ochraceous square at the center, a horizontal curved groove at apical third; tegmina not reaching tip of abdomen, two small black spots on posterior angles of clavus; last ventral segment shallowly bisinuate, almost truncate; genital parts green, except ovipositor, which is pink.

LUZON, Manila (*F. Q. Otanes;* type in my collection).

HECALUS CAPITATUS Distant.

Hecalus capitatus DISTANT, Fauna Brit. Ind. Rhynch. 7 (1918) 30.

Male, length, including tegmina, 8.5 millimeters.

Dirty ochraceous; vertex flat, impressed, and anterior margins slightly inflexed, continuously spotted with fuscous markings along border, profusely, finely punctured with brown specks, except a longitudinal, carinate, ochraceous median fascia, as long as breadth between eyes; face impressed across base, flat, sparsely marked; frons, cheeks, clypeus, and lora slightly tumid, frons broader at base, gradually tapering, clypeus oblong, body beneath including legs punctured or with brown markings, two profuse markings above eyes; pronotum transverse, about twice as broad as long, anterior margin almost truncate, posterior broadly sinuate, sparsely and slightly marked with minute punctures; scutellum about one and one-half times as broad as long, with a median, longitudinal, light brown band, and four horizontal, median, light brown spots, posterior angle acute and with curved impression on upper third; tegmina broad, posterior margin rounded, sparsely and irregularly marked with brown markings, wing veins amber color; eyes fuscous; ocelli ochraceous above eyes, surrounded by brown spots.

LUZON, Laguna Province, Los Baños (*S. Gonzales*). NEGROS, Occidental Negros Province, Victoria (*Baker*).

Originally described from northern Bengal. This species is here reported from the Philippines for the first time.

Genus THOMSONIELLA Signoret

Thomsonia SIGNORET, Ann. Soc. Ent. Fr. (1879) 51.

Thomsoniella SIGNORET, Ann. Soc. Ent. Fr. (1880) 52; MELICHAR, Hom. Fauna Ceylon (1903) 171; DISTANT, Fauna Brit. Ind. Rhynch. 4 (1908) 277–278.

Type, *T. porrecta* Walker.

The original name *Thomsonia* was changed to *Thomsoniella*, because *Thomsonia* had been used in the Crustacea. This genus is close to *Hecalus*, from which it is separated by having six discoidal areolæ and the following characteristics:

Body depressed; head prolonged in front, foliaceous on the anterior margin of the vertex, with a groove throughout its entire length, vertex depressed, also the frons, the latter with the grooves and lateral sutures extending to the anterior border of the head; gena sinuate, rounded in the middle, the lora occupying the entire space between the margin of the genæ and the frontal suture; sides of clypeus almost parallel, rounded at the tip, one and a half times longer than broad; pronotum transverse, almost broader than the head including the eyes; tegmina hyaline with a narrow marginal limbus.—SIGNORET, Ann. Soc. Ent. Fr. (1879) 51.

THOMSONIELLA PORRECTA Walker.

Thomsoniella porrecta WALKER (*Acocephalus*), List Hom. Suppl. (1858) 262; MELICHAR (*Thomsoniella*) part., Hom. Fauna Ceylon (1903) 173; DISTANT, Fauna Brit. Ind. Rhynch. 4 (1908) 278–279, fig. 178; BIERMAN, Notes Leyd. Mus. 3 (1913) 61, Java; DISTANT, Fauna Brit. Ind. Rhynch. 7 (1918) 31; BAKER, unpublished notes.

Platymetopius lineolatus MOTSCH., Etud. Ent. 8 (1859) 114; KIRKALDY (*Thomsonia*), Exp. Sta. Haw. Sugar Planters' Assoc. Bull. 1 pt. 9 (1906) 337.

Hecalus kirschbaumii STÅL, Öfv. Vet.-Akad. Förh. (1870) 737; SIGNORET (*Thomsoniella*), Ann. Soc. Ent. Fr. (1880) 52, pl. 1, fig. 4; ATKINSON, Journ. As. Soc. Bengal 54 (1885) 104.

Length, including ovipositor, 6.5 millimeters.

Pale ochraceous or greenish ochraceous, with small spot at the apex of clavus and another on the middle of the first apical area black; anterior margin of vertex usually blackish; some obscure longitudinal orange-red fasciæ which are sometimes obsolete, in other specimens visible as in the one here figured, these fasciæ number when fully discernible four on vertex, six on pronotum, and three on scutellum; vertex considerably shorter than breadth between eyes, its anterior margin distinctly reflexed, ocelli in groove very close to the eyes.—DISTANT, Fauna Brit. Ind. Rhynch. 4 (1908) 278–281.

Habitat: Calcutta, Ceylon, Pusa, Peradeniya, Negombo, Burma, Maldive Islands, Queensland, Philippines.

THOMSONIELLA ALBOMACULATA Distant.

Thomsoniella albomaculata DISTANT, Fauna Brit. Ind. Rhynch. 4 (1908) 280–281.

Length of male, including tegmina, 5 millimeters.

Pale ochraceous or greenish-ochraceous; apical areas of tegmina brownish with white spots; vertex of head with the lateral and apical margins somewhat strongly reflexed, extreme apical edge piceous; pronotum finely trans-

versely striate; scutellum with an angulate line before the apical area; in some specimens as the one here figured there are two darker basal spots, but generally these are obsolete; abdomen above black, the lateral margins somewhat broadly ochraceous and inwardly angulated, a sub-apical narrow greyish transverse fascia, the anal segment castaneous.—DISTANT, tom. cit., 281.

Originally known only in eastern Bengal, Calcutta, and Ceylon.

LUZON, Rizal Province, Alabang: Laguna Province, Los Baños (*J. Valdez,* in my collection).

This is the first Philippine record for this species. Apparently very common around Manila. Some of the specimens are parasitized by a dryinid.

Genus NIRVANA Kirkaldy

Nirvana KIRKALDY, Ent. 33 (1900) 293; MELICHAR, Hom. Fauna Ceylon (1903) 165; DISTANT, Fauna Brit. Ind. Rhynch. 4 (1908) 281.

Type, *N. pseudommatos* Kirkaldy.

Distant[63] places the members of this genus under the division Hecalusaria. Kirkaldy[64] founded this genus in 1900, which he states may be placed provisionally near the American genus *Spangbergiella* Signoret, a genus allied to *Hecalus* under Jassinæ. However, later on Kirkaldy[65] changed his opinion and placed it under the genus *Eupterigine,* which belongs to the Typhlocybinæ. Baker[66] has raised this genus to the category of a family, separated into three subfamilies mainly according to the position of the antennæ; namely, Macroceriinæ, Nirvaniinæ, and Stenometopiinæ. The Macroceratogoniinæ include the genera *Macroceratogonia* Kirkaldy, *Balbilus* Distant, and *Stenotortor,* a new genus erected by Baker, the characteristics of which were based upon the more highly specialized *Balbilus.* The type species is *Stenotortor inocarpi* Baker, collected in Singapore, Straits Settlements, on *Inocarpus edulis,* the Otaheite chestnut, supposed to have been introduced from Polynesia.

The Stenometopiinæ take in one genus, *Stenometopius* Matsumura, with the species *S. formosanus* Matsumura and *S. mindanaoensis* Baker. Baker believed that this genus may be represented in the islands between Formosa and Mindanao.

The Nirvaniinæ take in *Didius* Distant, which is provisionally placed in this subfamily by Baker, *Kana* Distant, *Nirvana* Kir-

[63] Tom. cit. (1908) 281 and 299.

[64] Ent. 33 (1900) 293.

[65] Exp. Sta. Haw. Sugar Planters' Assoc. Bull. 3 (1907) 68.

[66] Philip. Journn. Sci. 23 (1923) 345–401.

kaldy, *Ophiuchus* Distant, and the four genera separated by him; namely, *Pseudonirvana, Nirvanoides, Pythonirvana,* and *Jassonirvana.* These separations were based largely on the shape and characteristic sculptures of the vertex, on the position of the ocelli on the varying points of the crown, accompanied by peculiar surrounding structures, and in many cases the sizes and shapes of the tegminal cells.

In Baker's [67] synopsis the vertex of *Kana* is as long as or usually shorter than the anteocular width, which did not tally with any species. It should have been relatively shorter than the vertex of *Nirvana.* I have examined the species of *Kana* and found them to have the vertex longer than the distance between the eyes, tallying with Distant's synopsis which gives the face slightly longer than broad.

NIRVANA PHILIPPINENSIS Baker.

Nirvana philippinensis BAKER, Philip. Journ. Sci. 23 (1923) 385–386, pl. 4, fig. 31.

Length, including tegmina, 5 millimeters.

Very pale ochraceous; the delicate complete median carina of vertex is black, and a median stripe a little paler in color continuous across the pronotum and scutellum, and in some specimens the full length of claval commissure; ocellus seated in an orange spot. Tegmina milky translucent, three oblique fuscous stripes over the corresponding cross veins in apical half of subcostal area; a large orange spot covers apical portions of radial and medial areas; apical sugmargin fuscous, this extending into outer apical cell; a large round black spot at base of second apical cell; extreme apex of clavus fuscous. Length, female, 5 mm; male, 4.25 mm.—BAKER, loc. cit.

Baker's specimens were from Mount Maquiling, Luzon; and Dapitan, Zamboanga, Lanao, and Surigao, Mindanao.

LUZON, Laguna Province, Los Baños, Mount Banahao: Rizal Province, Alabang. NEGROS, Occidental Negros Province, La Carlota. The specimens were compared with the type in the United States National Museum. It is evident that this species is well distributed.

Division SELENOCEPHALARIA

The general characteristics of the species belonging to this division are as follows: Vertex short, about one-half as long as distance between the eyes, more or less rounded anteriorly, the ocelli near the anterior margin of the eye and near the eyes.

[67] Tom. cit. 379.

The following key may serve to separate the genera determined in this paper:

Key to the Philippine genera of the division Selenocephalaria.

a [1]. Veins of tegmina very distinctly brown-margined, the cellular areas pronounced, the frons more or less rounded; vertex not apically transversely sulcate, the apical margin more or less reflexed and ridged. *Paramesus* Fieber.

a [2]. Veins of tegmina very distinct and cellular areas not all brown-margined, frons more or less elongated.

b [1]. Vertex moderately transversely sulcate near apex and ridged at the edge, more than one-half as long as width between eyes, ovipositor and pygofer short and stout................................ *Roxasella* gen. nov.

b [2]. Vertex moderately transversely sulcate near apex and ridged at the edge, more than one-fourth as long as width between eyes, ovipositor and pygofers more or less long and slender. *Omanella* gen. nov.

a [3]. Veins of tegmina normal, claval veins not connected, apical areas of tegmina reticularly veined.

b [1]. Vertex almost as long as width between eyes, body elongated and slender, wings very much longer and tapering. *Parabolocratus* Uhler.

b [2]. Vertex moderately transversely sulcate near apex and ridged at the edge, one-half as long as width between eyes........ *Krisna* Kirkaldy.

Genus PARAMESUS Fieber

Paramesus FIEBER, Verh. Zool-Bot. Ges. Wien 16 (1866) 506.

Type, *P. nervosus* Fall., a Palæarctic species.

Distribution: Nearctic, Palæarctic, and Oriental Regions.

Margin of vertex linear, ridged above and below margin with short fine transverse wrinkles parallel to margin, hollowed out on the upper surface, the margin of vertex consequently somewhat raised; the whole face very finely shagreened; clypeus somewhat long, gradually widened to apex, almost spatulate, "Zügel," not extending to end of clypeus, cheeks and middle of the sides very obtusely angulated, almost round; pronotum in front very flatly curved; face to vertex on ridge nearly subright-angularly obtuse, to the clypeus suddenly narrowed; ocelli on the ridge of vertex near the eyes; veins of tegmina distinct, the brown bordering of the veins strongly pronounced, the inner forked branch of first sector connected with the internal vein by two transverse veins so that there are two discal cells, three middle cells and five terminal cells are also formed; no marginal appendage. Direction of veins in tegmina as in *Selenocephalus*.—MELICHAR, cited by DISTANT, Fauna Brit. Ind. Rhynch. 4 (1908) 293.

PARAMESUS LINEATICOLLIS Distant.

Paramesus lineaticollis DISTANT, Fauna Brit. Ind. Rhynch. 4 (1908) 294, fig. 186.

Length, 5 to 6 millimeters.

Vertex, pronotum and scutellum ochraceous; vertex with an arcuated transverse black fascia between the eyes, behind the fascia is a short

medial incised dark line extending to base; pronotum with five longitudinal narrow fasciæ, the central narrowest and darkest, those on each side paler, broader and more brownish in hue; body beneath and legs pale ochraceous; face transversely brownly striate, medially longitudinally palely interrupted, on each side of clypeus a pale elongate spot outwardly margined with black; abdomen beneath with a marginal series of small piceous spots; posterior tibiæ streaked and spotted with piceous; tegmina dull pale ochraceous, the veins very prominent and much paler, a central prominent discal brown spot sometimes preceded nearer base by one or two smaller and linear dark spots; vertex short, transverse, rounded anteriorly, about three times as broad as long; face sub-convex; tibiæ longly spinulose.—DISTANT, loc. cit.

LUZON, Rizal Province, Alabang (Merino collection): Nueva Vizcaya Province, Bayombong. BASILAN (Osborn collection).

This species was originally described by Distant from Bengal, and is now reported for the first time from the Philippines where it may be of wide distribution.

Genus ROXASELLA novum

Type, *R. camusi* sp. nov.

Body oblong; vertex produced in front, slightly longer than one-half the distance between eyes, flat, finely diagonally striated; face dilated, depressed at base, antennæ located in impressions at base of cheek between eyes and space below base of frons; ocelli situated at apex of vertex, close to eyes and above the sulcated area of antennal base; pronotum transverse, distinctly quadrilateral, anterior margin rounded, slightly produced to between eyes, sides short and oblique; posterior margin slightly arcuated, two-thirds of posterior area roughly striated, anterior third slightly irregularly elevated; scutellum triangular, slightly broader than long; tegmina extending beyond tip of abdomen, venation similar to that of *Selenocephalus*. Closely related to *Selenocephalus*, differing mainly in shape of vertex, which in *Selenocephalus* is broadly rounded at the apex, and about one-half as long as half of distance between eyes, and the shape of pronotum which is rounded on anterior margin, and slightly more arcuated at posterior margin, and with the shallower excavation of cheek at base of antennæ.

LUZON, Laguna Province, Mount Maquiling. There are specimens of this genus in the Baker collection from Borneo and Singapore.

This genus is erected in honor of Dr. Manuel L. Roxas, chairman of the National Research Council, because of his interest in insect control.

ROXASELLA CAMUSI sp. nov.

Female, length, about 7.25 millimeters; male, length, about 7.

Vertex brown, with a narrow ochraceous band at extreme anterior margin, preceded by a fuscous band two and two-thirds times as long as distance between the eyes; ocelli at apex of vertex just above and close to eyes; eyes fuscous; face ochraceous; base of frons rounded with fuscous band, a deep excavated part above cheek, between base of frons and eyes, where antennæ are located, clypeus narrower at base; pronotum brown, roughly and transversely striate at posterior two-thirds, scutellum triangular, slightly wider than long, anterior portion brown, posterior angle ochraceous; tegmina semitransparent pale brown, long veins brown, crimson bands on commissural region, on claval-suture region, and on costal and first apical cells; pectoral and abdominal regions ochraceous with a light brown tinge, posterior legs spinulose and regularly marked with brown; last ventral segment longitudinally carinate, protruding slightly at center.

LUZON, Laguna Province, Los Baños (holotype, *S. Gonzales;* allotype, Baker collection, U. S. N. M.).

This species is named for Mr. Jose S. Camus, ex-director of the Bureau of Plant Industry and now undersecretary of the Department of Agriculture and Commerce, in recognition of his interest in promoting entomological work in this bureau.

ROXASELLA LOSBAÑOSA sp. nov.

Female, length, 8 millimeters; male, length, 7.

Light brown, with fuscous markings on vertex, pronotum, scutellum, commissural region of the clavus, and last third (apical region) of tegmina; venation golden yellow.

Vertex with ochraceous marginal stripe preceded by fuscous band, separated at the middle, anterior half of the vertex ochraceous; posterior two-thirds of pronotum finely, transversely striate and finely punctate; scutellum ochraceous with brown markings on central, lateral, and apical portions; face ochraceous with fuscous marks on basal margin of frons bordering apex of vertex; sternal region dark brown; venter ochraceous with brownish tinge; tegmina ochraceous with fuscous blotches on upper portion of two outer apical cells, and the tip of the wing cover.

LUZON, Laguna Province, Los Baños (type, Baker collection, U. S. N. M.); MINDANAO, Surigao, Lanao, Zamboanga (paratypes). The paratypes are slightly darker brownish.

Genus OMANELLA novum

Type, *O. barberi* sp. nov.

Vertex depressed, slightly produced in front, rounded, slightly, transversely sulcate and reflexed at apex, about one-third as long as distance around posterior margins of eyes; ocelli ochraceous, on the apex of vertex, distance from eye to ocellus one-fourth the distance between ocelli; general shape of frons somewhat triangular, broad at base and tapering towards clypeus. Clypeus elongate, broader at apex than at base. Shape and sculpture of pronotum and scutellum, the position and venation of tegmina similar to that of *Roxasella,* except that the first apical cell is smaller than the first anteapical, while that of *Roxasella* is equal in size to the first anteapical. The main difference from *Roxasella,* however, is in the size and shape of the vertex. The location of the ocelli is immediately above the eyes in *Roxasella,* and the antennal pit is shallower in this genus than in *Roxasella.* The pronotum is less sculptured in *Omanella.* The ovipositor and pygofer of this genus are long and slender; the ovipositor greatly exceeds the pygofer.

The genus is named in honor of Mr. Paul W. Oman, taxonomist in charge of auchenorhynchous Homoptera in the United States National Museum, whose valuable assistance and timely suggestions to the writer in the preparation of this paper are very much appreciated.

OMANELLA BARBERI sp. nov.

Female, length, including tegmina, 6 millimeters; male, length, including tegmina, 5.5.

Body ochraceous, vertex and pronotum slightly greenish ochraceous, each dorsal segment of abdomen with brown bands. Vertex greenish ochraceous with four black spots in a row near apex and two at posterior margin, distance between ocellus and eye almost one-third that of distance between ocelli themselves; pronotum greenish ochraceous, rounded anteriorly, slightly sinuate posteriorly, two-thirds posterior area finely punctate and striate, six dark spots at middle (three on each lateral side); scutellum ochraceous, with an oblique faint brown patch on each anterolateral angle, posterior angle differentiated by a transverse sulcus, finely striate, and with a brown dot on each lateral side; tegmina greenish amber, wing veins transparent amber, with a piceous marking on the ends of the outer and inner claval veins, and the claval suture at the point of union with the vein bound-

ing the commissural region, and brownish markings on veins practically in all angles of every cell; pectus, legs, and abdomen ochraceous, last ventral segment in male truncate, with two smoky semitransparent markings near middle; last ventral segment of female slightly notched at center, abdomen greatly tapering, ovipositor long, pointed, and distended far beyond pygofer, reaching almost to tips of tegmina.

The species is named for Mr. H. G. Barber, taxonomist in charge of the Hemiptera-Heteroptera in the United States National Museum.

MINDANAO, Zamboanga. BASILAN (type, Baker collection, United States National Museum).

OMANELLA PHILIPPINA sp. nov.

Female, length, 8 millimeters; male, length, 6.5.

Olive-green, face greenish ochraceous, pectoral and ventral regions greenish gray, prosternal region with black blotches. Vertex rounded, about one-fourth as long as distance between eyes, which are orange above and dark below, with two confluent orange spots occupying practically the whole frontal half of vertex, three distinct black dots on midsection; frons abruptly tapering towards the clypeal suture; clypeus narrowest at suture, abruptly enlarging towards apex; face greenish yellow; front tibiæ orange; the two posterior with an orange blotch near femora; pronotum slightly wider than long, olive-green, with two small orange spots at middle of anterior margin, two large orange spots on midsection of pronotum, and one small orange spot on each lateral side; scutellum lighter green, with two orange blotches on each of the anterior angles; two on middle of lateral side, and one at apex of posterior angle; tegmina coriaceous smoky hyaline, wing veins testaceous, with orange stripes on commissural region, an orange spot on each humeral angle, and an orange stripe along costal vein.

This is one of Baker's manuscript species the type of which is labeled *Selanocephalus philippinensis* sp. nov. in the Baker collection. It differs from the type of *Selanocephalus* in the general shape of the face, the shape and sulca of the vertex, the shape of the pronotum, and the folding of the tegmina. The robust posterior tibia, which is slightly compressed and densely spinulose, one of the outstanding characteristics of *Selanocephalus*, is not present in this species.

MINDANAO, Zamboanga (type, Baker collection, U. S. N. M.).

OMANELLA JOHNSONI sp. nov.

Female, from middle of vertex to tip of ovipositor, 9.5 millimeters; male, from middle of vertex to tip of tegmina, 8.

Greenish ochraceous dorsad, and ochraceous ventrad, sides of body brown with a narrow pale ochraceous band on the posterior side of each abdominal segment; vertex with four black spots in a row, on depressed portion near apex, and two on posterior side, one-third of the distance from the eye to the distance between the spots; ocelli on the margin of vertex ochraceous. Pronotum, scutellum, and tegmina with the same color and markings as those of *O. barberi*, but the claval suture more golden in color. Very close to *O. barberi*, but larger. Last ventral segment of male a little rounded in front; ovipositor slenderer and relatively longer than that of *O. barberi*. The sheath projecting beyond the tips of tegmina.

I take pleasure in naming this beautiful species for Miss Dorothy Johnson, graduate assistant of the Ohio Biological Survey, whose assistance was gratefully received during the early part of this work.

MINDANAO, Zamboanga. BASILAN (type and paratypes, Baker collection, U. S. N. M.).

Genus PARABOLOCRATUS Uhler

Parabolocratus UHLER, Proc. U. S. Nat. Mus. 19 (1896) 291.
Parabolopona MATSUMURA, Coll. Agr. Hokuku Imp. Univ. Pub. 4 (1912).

Type, *P. guttatus* Uhler.

Probable distribution: Oriental.

This genus was erected by Uhler, but later Matsumura [68] gave it the name *Parabolopona*.

Elongate, slender; vertex almost as long as wide, triangularly rounded in front, a little expanded at the margin between the middle and the eyes, the margin a little upturned; eyes blunt, triangularly elongated; ocelli at apex of vertex immediately after the eyes and above the antennæ; pronotum transverse, anterior margin rounded, the lateral obliquely rounded, and the posterior gradually concave, almost as long as vertex which is longer than scutellum, surface finely wrinkled; scutellum with surface finely wrinkled, broader than long, the posterior angle separated by an arcuated suture; tegmina long, slender, and tapering, with four apical cells.

[68] Coll. Agr. Hokuku Imp. Univ. Pub. 4 (1912).

This genus is here reported from the Philippines for the first time.

PARABOLOCRATUS GUTTATUS Uhler.

Parabolocratus guttatus UHLER, Proc. U. S. Nat. Mus. 19 (1896) 291.
Parabolopona guttatus MATSUMURA, Coll. Agr. Hokuku Imp. Univ. Pub. 4 (1912); 6,000 Illustrated Insects of Japan-Empire (1931).

Length to tip of wing covers, 6 to 7 millimeters; width of pronotum, 2.

Elongated, bright pea-green, polished. Head almost as long as wide; angularly rounded in front, the subacute apex a little upturned; eyes brown, long, bluntly angular on the inner side, the depressed middle crossed by two impressed lines, and a very slender impressed line on the middle; antennæ very long and slender, yellow from base to middle, brown from thence to tip. Pronotum short, sublunate, with the lateral ends diagonal and moderately rounded, the surface very finely wrinkled. Sternum and legs paler, the femora with some black specks, the tibiæ dotted with black and with black spines. Wing covers wedge-shaped when closed, a little tinged with yellow above the margin of the clavus marked with two black, small spots, one of which is on the apex, apical ends of membrane with two or three black traces, the surface highly polished.—UHLER, loc. cit.

LUZON, Mountain Province, Haight's Place (Osborn collection); Baguio (Baker collection, U. S. N. M.).

Genus KRISNA Kirkaldy

Siva SPINOLA, Mem. di Matem. e di Fis. Soc. Ital. Modena (1852) 167; STÅL, Hem. Afr. 4 (1866) 112; SIGNORET, Ann. Soc. Ent. Fr. (1880) 197; ATKINSON, Journ. As. Soc. Bengal 54 (1885) 107; MELICHAR, Hom. Fauna Ceylon (1903) 167, nom. praeocc.
Krisna KIRKALDY, Entomologist 33 (1900) 243, nom. nov.; DISTANT, Fauna Brit. Ind. Rhynch. 4 (1908) 297.
Eogypona KIRKALDY, Entomologist 34 (1901) 38.

Type, *K. strigicollis* (Spinola).
Distribution: Ethiopian and Oriental Regions.

Body oblong, somewhat depressed, above slightly convex; vertex narrower than the pronotum, short, rounded anteriorly or obtusely subangularly rounded, anterior margin somewhat acute but not foliaceous, vertex horizontal, flat, about twice as broad as the eyes; face dilated, frons and clypeus somewhat flat; frons longer than broad; clypeus spatuliform; genæ broad with the angle more or less angular and more or less emarginate; ocelli placed at the eyes on the anterior margin of the head; pronotum transverse, anteriorly narrowed, twice as broad as long slightly rounded at anterior margin, almost straight before the scutellum, lateral margins acute, scutellum triangular, a little broader than long; tegmina barely extending beyond the abdominal apex, apically narrow, irregularly veined; legs moderate, posterior femora compressed; posterior tibiæ very spinose.—ATKINSON, cited by DISTANT, loc. cit.

KRISNA STRIGICOLLIS Spinola.

Acocephalus stramineus WALKER, List Hom. 3 (1851) 847; SIGNORET, Ann. Soc. Ent. Fr. (1879) 88.

Krisna strigicollis SPINOLA (*Siva*), Mem. Mat. Fis. Soc. Modena (1852) 167; SIGNORET, Ann. Soc. Ent. Fr. (1880) 198, pl. 6, fig. 64; ATKINSON, Journ. As. Soc. Bengal 54 (1885) 108; KIRKALDY (*Krisna*), Entomologist 33 (1900) 243; BIERMAN (*Siva*), Notes Leyd. Mus. 29 (1907) 166; DISTANT, Fauna Brit. Ind. Rhynch. 4 (1908) 297–298, fig. 189; MELICHAR, Notes Leyd. Mus. 36 (1913) 131, Java.

Bythoscopus testaceous WALKER, Journ. Linn. Soc. Zool. 1 (1857) 173.

Bythoscopus indicatus WALKER, List Hom. Suppl. (1858) 266.

Selenocephalus costalis STÅL, Freg. Eug. Resa Ins. (1859) 290; (*Siva*), Ann. Soc. Ent. Fr. (1864) 66; Öfv. Vet.-Akad. Förh. (1870) 736.

Length, including tegmina, 10.5 to 13 millimeters.

Greenish ochraceous to pale ochraceous; vertex short, about half as long as distance between eyes, narrower than pronotum, flat, slightly impressed, front margin reflexed, a discontinuous arcuate fuscous fascia bordering margin from eye to eye, crossing them with a longitudinal suture from center of posterior margin to apex of vertex, pronotum transverse, anteriorly rounded transversely and strongly striate; scutellum broad, about one and one-third as broad as long; tegmina with an oblique impression near each lateral angle, an arcuate impression near tegmina profusely punctated, with two small black markings at the apices of the clavus, anterior posterior margin from clavus down smoky white; posterior legs thickly decorated with stout spines.

Known host, *Acalypha* species.

Distant [69] reported the distribution as Bengal, Kangra Valley, Bombay, Nilgiri Hills, Burma, Tenasserim, Malay Peninsula, Cambodia, Java, Borneo, Celebes, North China, Philippines.

LUZON, Laguna Province, Los Baños, Mount Banahao: Rizal Province, Alabang (*Merino*): Tayabas Province, Panaon: Mountain Province, Trinidad (Osborn collection). NEGROS, Negros Occidental Province, La Carlota (*Merino*). BILIRAN (Osborn collection).

KRISNA STRIATA Kirby.

Krisna striata KIRBY (*Gypona*), Journ. Linn. Soc. Zool. 24 (1891) 171; MELICHAR (*Siva*), Hom. Fauna Ceylon (1903) 167; DISTANT, Fauna Brit. Ind. Rhynch. 4 (1908) 298–299, fig. 190.

Eogypona kirbyi KIRKALDY, Entomologist 34 (1901) 39.

Length, including tegmina, about 13 millimeters.

[69] Fauna Brit. Ind. Rhynch. 4 (1908) 298.

Yellowish green, the vertex slightly more angular and more pointed than in the preceding species; the venation is green while that of the closely related *strigicollis* is yellow. The tegmina are not as compact; they are more spread and rather pubescent, and not rugulose or punctate.

The distribution as reported by Distant,[70] is Ceylon, Kandy, Maskeliya, Pundaluoya, Peradeniya, Muruwale, Gumaduwa, Haputale, Keigalle.

LUZON, Nueva Vizcaya Province, Imugan (Osborn collection). Hitherto not recorded in the Philippines.

Division TARTESSUSARIA

To this division belong the species having the vertex about or more than three times broader between eyes than long, and with the ocelli near the anterior margin and nearer to the eyes than to each other. The two genera are separated by the following characteristics:

Vertex and pronotum both angularly produced in front of eyes. *Tartessus* Stål.

Vertex alone angularly produced in front of eyes; pronotum twice, or slightly more than twice, as long as vertex.................. *Drabrescus* Stål.

Genus TARTESSUS Stål

Tartessus STÅL, Öfv. Vet.-Akad. Förh. (1865) 156; SIGNORET, Ann. Soc. Ent. Fr. (1878) 347; SPANGBERG, Öfv. Vet.-Akad. Förh. No. 9 (1877) 3; DISTANT, Fauna Brit. Ind. Rhynch. 4 (1908) 302–303.

Type, *T. ferrugineus* Walker.

Distribution: Eastern British India, Malay Peninsula and Archipelago.

Body oblong; vertex broad, short, in front of eyes strongly angularly roundly produced, shorter or narrower at apex; head beneath strongly reclinated, face moderately flattened, a little narrowed posteriorly; eyes large, oblique; ocelli placed on margin of vertex near eyes; pronotum large, anteriorly very strongly, roundly, and subangularly produced; scutellum longer than broad, about as long as pronotum; tegmina oblong, apex somewhat valvate, apical cells five; posterior densely spinulose.—DISTANT, loc. cit.

TARTESSUS FERRUGINEUS Walker.

Tartessus ferrugineus WALKER (*Bythoscopus*), List Hom. 3 (1851) 865–866; STÅL (*Tartessus*), Öfv. Vet.-Akad. Förh. (1870) 738; SPANGBERG, Öfv. Vet.-Akad. Förh. No. 9 (1877) 7; SIGNORET, Ann. Soc. Ent. Fr. (1880) 356; DISTANT, Fauna Brit. Ind. Rhynch. 4 (1908) 303, fig. 193; BANKS, Philip. Journ. Sci. § D 4 (1909) 553; MELICHAR, Notes Leyd. Mus. 36 (1913) 131.

[70] Tom. cit. 299.

Bythoscopus malayus STÅL, Freg. Eug. Resa Ins. (1859) 290, *B. biarcuatus, unilineatus, unifascia* Walker MS.; STÅL (*Tartessus*), Öfv. Vet.-Akad. Förh. (1865) 156; SIGNORET, Ann. Soc. Ent. 1880) 157.

Female, length, including tegmina, 10 millimeters; male, 8.

Tawny, rather narrow, tapering from the head to the tip of the abdomen; head minutely punctured, very short, conical, a little broader than the chest, black along the fore border, extremely concave behind crown, extremely short in the middle where its length is not one-tenth of its breadth, rather broader on each side; under side transversely striated, across scutcheon minutely punctured, having on each side of the fore border a triangular compartment, which is partly smooth, partly slightly striated; breast partly black on each side; abdomen black; hind borders of the segment tawny; veins of the forewings few, black, excepting those along the hind border; hind wings gray.—WALKER, List Hom. 3 (1851) 865–866.

This species was originally described from Java, and its distribution is given by Distant[71] as Tenasserim, Malay Peninsula; Perak, Malacca, Java, Mysol, and Japan. Banks[72] made the first Philippine record. The available material indicates that the species is present all over the Philippines. Known host plant, mango.

TARTESSUS MALAYUS Stål.

Tartessus malayus STÅL, Freg. Eug. Resa Ins. 290; Öfv. Vet.-Akad. Förh. (1865) 156.

Tartessus ferrugineus STÅL, Öfv. Vet.-Akad. Förh. (1870) 738; SPANGBERG, Öfv. Vet.-Akad. Förh. No. 9 (1877) 7; SIGNORET, Essai sur les Jassides (1878) 357–358, pl. 9*e*, fig. 82.

Length, including tegmina, as in *ferrugineus*, 8 to 10 millimeters.

This species was described by Stål in 1859, who in 1870 considered it to be a synonym of *T. ferrugineus* Walker. However, Signoret[73] considered it a distinct species. It is very similar to *ferrugineus* in size and color, with certain slight differences of coloration of the tegmina and venation, features that, however, are not very constant. For example, the black band on the costal area is sometimes absent in *ferrugineus*. The venation in *malayus*, which is black or piceous, is also found on at least the lateral area of *ferrugineus*. The main difference is the presence of the double arcuate marginal black bands on the upper region of the frons in this species, instead of the single arcuate

[71] Fauna Brit. Ind. Rhynch. 4 (1908) 303.
[72] Philip. Journ. Sci. § D 4 (1909) 553.
[73] Essai sur les Jassides (1878) 357–358.

marginal black band between the eyes, which sometimes is even absent.

Vertex and pronotum yellowish brown, vertex finely punctate, pronotum transversely striate; scutellum amber brown, quite long, about one and one-half times as long as wide; tegmina bronzy brown, veins black or fuscous, costal area black; face with double marginal black bands on the upper region of face. In some males these markings are even more accentuated by a longitudinal median band which is continuous to the clypeus. In others only certain black markings on the clypeus and lora are present; lateral margins of sternum with a black area.

Distribution: Malacca, Philippines, and Formosa.

LUZON. MINDORO. BASILAN. (Osborn collection). One specimen has been taken in Formosa. I believe that this species is as widely distributed as *T. ferrugineus*.

TARTESSUS FIEBERI Stål.

Tartessus fieberi STÅL, Öfv. Vet.-Akad. Förh. (1865) 158; (1870) 738; SPANGBERG, Öfv. Vet.-Akad. Förh. No. 9 (1877) 9; SIGNORET, Essai sur les Jassides (1878) 359–360; BANKS, Philip. Journ. Sci. § D 5 (1910) 51.

Female, length, including tegmina, 12 millimeters; male, 10.

Vertex chestnut-brown, pronotum black, with a short brown stripe below the eyes, and faint, narrow, brown lateral and posterior marginal stripe, transversely striated; scutellum black, minutely shagreened, except a small lateral triangle which is smooth, about one and one-half times as long as broad, marginal angle pointed, with brown margin, an inverted median anchor-shaped impression on the scutellum; tegmina chestnut-brown with piceous or fuscous venation; black band within the costal area as in the two preceding species; eyes and ocelli brown; black arcuated line below apex of vertex, frons, lora, clypeus, and anterior half of cheek black; the rest of the face golden brown; legs brown, except posterior femora which are black; hind tibia spinulose.

Distribution, according to Signoret,[74] Mysol and Philippines.

LUZON, Bataan Province, Limay (Osborn collection); Laguna Province, Mount Banahao (*Merino*). MINDANAO, Lanao Province, Mumungan: Surigao Province, Surigao. SAMAR, Catbalogan. BILIRAN. BASILAN. These records indicate that this species is as widely distributed in the Philippines as either of the two preceding species.

[74] Op. cit. 359–360.

Genus DRABESCUS Stål

Drabescus STÅL, Öfv. Vet.-Akad. Förh. (1870) 738; DISTANT, Fauna Brit. Ind. Rhynch. 4 (1908) 304.

Type, *D. remotus* Walker, from the Philippines.
Distribution: India, Malaya.

Ocelli remote from the eyes, almost more so than the antennæ; anterior tibiæ above broadly subsulcate; superior margin of the anterior tibiæ distinctly dilated (Stål). Vertex broadly transverse, short, moderately concave, the anterior margin ridged; head beneath much broader than long, the face a little longer than broad, somewhat flat; pronotum transverse, much broader than long, anterior margin convex; scutellum large, broad, subtriangular; tegmina with four large distinct apical cells divided by smooth veins, the remaining venation punctate.—DISTANT, loc. cit.

DRABESCUS REMOTUS (Walker).

Drabescus remotus WALKER (*Bythoscopus*), Cat. Hom. Ins. Suppl. 32 (1851) 866; DISTANT, Fauna Brit. Ind. Rhynch. 4 (1908) 304.
Bythoscopus ater WALKER, Cat. Hom. Ins. Suppl. 43 (1851) 871; STÅL (*Selenocephalus*, subgenus *Drabescus*), Öfv. Vet.-Akad. Förh. (1870) 738; SIGNORET, Essai sur les Jassides (1870) 208.

Female, length, including tegmina, 10 millimeters; male, 8. Pale ferrugineus, mottled with fuscous. Vertex broadly transverse, very short, about one-fifth as long as wide, slightly concave in front; pronotum transversely rounded anteriorly and broadly concave posteriorly, deeply, transversely striated; scutellum large, as long as wide; tegmina leathery, hyaline, posterior portion folded in almost perpendicularly, venation punctate, posterior fourth smooth-veined, distinctly four apical cells.

Distribution: Philippines.

LUZON, Laguna Province, Mount Banahao (*Merino*): Nueva Viscaya Province, Imugan: Mountain Province, Haight's Place. MINDANAO, Surigao. BILIRAN (Osborn collection). This species is widely distributed in the Islands.

Division JASSUSARIA

The insects of this division are easily recognized by the nonlaterally ridged and nondiscally foveate or excavate vertex, the lateral margins more or less obliquely, basally narrowed at inner margins of the eyes. *Jassus* is the only genus determined.

Genus JASSUS Fabricius

Jassus FABRICIUS, Sust. Rhyng. (1803) 85.
Coelidia GERMAR, Mag. d. Ent. 4 (1821) 38 and 75.
Deridna WALKER, List. Hom. Suppl. (1858) 319.

Type, *J. nervosus* Fabricius.
Distribution: Cosmopolitan.

Body oblong, vertex obtuse, longer than width between the eyes, narrower than pronotum, narrow at margin between eyes, then gradually broadened above; pronotum short, greatly transversed, shorter than the scutellum; scutellum large, narrower than long; tegmina apically margined with five apical cells, but no anteapical; vertex with eyes narrower than pronotum, face widened downward; clypeus greatly broadened at base.

JASSUS CONSPERSUS Stål.

Coelidia sparsa STÅL, Öfv. Vet.-Akad. Förh. (1854) 254; Freg. Eug. Resa Ins. (1859) 290–316.

Jassus conspersus STÅL, Hem. Ins. Philip. (1870) 735; SPANGBERG, Öfv. Vet.-Akad. Förh. No. 8 (1878) 25; MELICHAR, Notes Leyd. Mus. 36 (1913) 133; BAKER, Philip. Journ. Sci. § D 10 (1915) 55–56.

Female, length, including tegmina, 9.25 millimeters; male, 8.

This species is brown to fuscous and well marked by yellow spots; vertex slightly longer than width between eyes, with two light brown carinate plates running longitudinally, separated by median groove, narrower at the posterior margin; frons yellowish with reddish lateral stripes at the clypeus strongly broadened apically; upper tip of lora acute; hind margin of last ventral segment of female subtruncate at center and somewhat sinuate at sides.

Habitat: Luzon, Philippine Islands.

LUZON, Laguna Province, Los Baños: Rizal Province, Alabang (1 female and 3 males).

JASSUS MINDANAOENSIS sp. nov.

Female, length, including tegmina, about 10 millimeters.

Greenish ochraceous, quite close to *J. conspersus*. Vertex greenish brown, longer than distance between eyes; ocelli brown; eyes fuscous; pronotum fuscous, thickly covered with greenish ochraceous granules. Scutellum subequilateral, light amber brown, with two broad fuscous areas on center of scutellum equidistant from lateral and basal margins, and thickly covered with greenish ochraceous granules; face greenish ochraceous; frons about twice as long as broad between the eyes, dimly, laterally striate with short, greenish, perpendicular lines; margined above with narrow, longitudinal, greenish fascia between eyes and frons; cheeks and clypeus greenish ocher; body beneath abdomen fuscous; venter ochraceous, except the center of last segment and ovipositor, which are fuscous; thorax stramineous, two anterior legs ochraceous brown; anterior claws brown and the two last pairs fuscous; the posterior legs stramineous, armed with large fuscous spurs.

This species is quite similar in the contours of the parts of the body to *J. conspersus.* The greatest difference is in the last ventral segment of the female genitalia, that of *conspersus* being sinuate at the side and truncate at the center, while that of *Jassus mindanaoensis* is slightly bisinuate. This species is slightly larger than *J. conspersus.*

MINDANAO, Butuan (*Pablo S. Soriano;* type in my collection).

Division ATHYSANUSARIA

This division of cicadellids is distinguished by the three anteapical areoles, the outer branch of the first sector of the elytra with two forks; the vertex only half as long as, or less than, the width between the eyes; face not longer than the breadth between the bases of antennæ.

The only forms described are species of *Athysanus,* and its subgenus *Stirellus,* erected by Osborn and Ball [75] and later raised to the category of a genus.

Genus ATHYSANUS Burmeister

Athysanus BURMEISTER, Gen. Ins. 1–14 Subg. 2 (1840); EDWARDS, Trans. Ent. Soc. Lond. (1888) 35; VAN DUZEE, Trans. Am. Ent. Soc. 19 (1892) 299; MELICHAR, Hom. Fauna Ceylon (1903) 182; DISTANT, Fauna Brit. Ind. Rhynch. 4 (1908) 343.

Type, *A. argentatus* Fabricius, a Palæarctic species.

Distribution: General.

Robust; vertex with the eyes wider than the pronotum, obtusely produced, convex above, ocelli at apex of vertex, near eyes; frons, clypeus, and cheek wider at their bases; cheek reaches clypeus at end; pronotum transverse; tegmina overlap at apex, appendix well developed.

ATHYSANUS ATKINSONI Distant.

Athysanus atkinsoni DISTANT, Fauna Brit. Ind. Rhynch. 4 (1908) 345.

Length, including tegmina, 4.5 millimeters.

Smoky ochraceous, vertex triangularly produced, two fuscous markings below ocelli; a black fascia on vertex between eyes; a fine furrow or median sulcus from fascia to posterior margin of vertex. Frons tumid, almost as broad as long, with transverse brown striæ; cheeks abruptly impressed between eyes; pronotum dark grayish with anterior lateral margin ochraceous; posterior lateral margin with a narrow ochraceous line; scutellum ochraceous, with three discernible rectangular brown mark-

[75] Ohio Naturalist 2 (1902) 25, 250.

ings on anterior margin, and one on apical angle; two dark spots below apex of vertex; face with short transverse striæ; body beneath ochraceous, anterior half of each abdominal segment dark brown; tegmina grayish subhyaline; veins pale brownish; hind femora with oblique whitish striæ.

LUZON, Rizal Province, Alabang.

Genus STIRELLUS Osborn and Ball

Stirellus OSBORN and BALL, Ohio Naturalist 2 (1902) 250 (subgenus).

Type, *Athysanus* (*Stirellus*) *bicolor* Van Duzee.

Head about as wide as pronotum, vertex narrow, rarely as wide as the long diameter of an eye, usually longer than its basal width. Front inflated, almost touching eyes above; vertex and front produced into a long, conical point, their margins indistinct. Elytra narrow, about as long as the abdomen; venation as in *Athysanus*, regular.—OSBORN and BALL, loc. cit.

STIRELLUS NIGRIPECTUS sp. nov.

Male, length, including tegmina, 2.5 millimeters; female, 3.

Vertex, pronotum, scutellum, and frons greenish yellow; tegmina smoky gray, legs ochraceous; pectus and venter black, except last ventral segment and anal plates pale ochraceous. Vertex angularly produced, pointed, almost as wide as long; ocelli at the apex of vertex, just above eyes, piceous; eyes black; frons light brown with ochraceous transverse striæ; clypeus small; almost perpendicular; pronotum transverse, shorter than length of vertex, rounded anteriorly with two faint, parallel, transverse, dark grayish lines; scutellum small, broader than long, with one green spot on each basal angle; a transverse suture on middle; venation milky white; last ventral segment almost truncate, pale ochraceous; pygofer profusely bristled.

LUZON, Rizal Province, Alabang (types and paratypes in my collection): Manila (paratypes, Osborn collection).

The species described herewith was collected from Alabang, Luzon. Professor Osborn's specimens, which were determined later, are from Manila.

Division THAMNOTETTIXARIA

This division of cicadellids differs from Athysanusaria in the proportion of the face, which is longer than broad, while that of Athysanusaria is not longer than broad.

In this group, *Nephotettix* Matsumura and *Eutettix* Van Duzee are the representatives studied. The genus *Nephotettix* is separated from other genera of this division by the following

synoptic characters: Breadth of vertex between eyes considerably shorter than length of pronotum and scutellum together. Clypeus broadest at base.

Distant's [76] description of *N. bipunctatus* tallies with the above description.

Genus NEPHOTETTIX Matsumura

Nephotettix MATSUMURA, Termész. Füzetek **25** (1902) 378; MELICHAR, Hom. Fauna Ceylon (1903) 192; DISTANT, Fauna Brit. Ind. Rhynch. **4** (1908) 359.

Type, *N. cincticeps* Matsumura, from Japan.

Distribution: Eastern Palæarctic, Ethiopian, Oriental, Malayan, and Australian Regions.

Body narrow, compressed, vertex short, in front broadly rounded, union of vertex to front rounded, a transverse furrow rather near front margin running from one eye to the other, frontal margin rather upcurved, the disk of vertex arched; ocelli at union of vertex to front, not close to eyes and on the inside of the suture of the face and cheeks; face broad as long or shorter than the width of the cheek-angles, flat, at the ocelli twice as broad as the clypeus, margins of the clypeus flatly curved; clypeus extending beyond the margins of the cheeks, somewhat quadrangular, broadest at base; pronotum longer than the medial length of vertex, on posterior margin very flatly curved, at the sides strongly rounded; tegmina at apices broadly rounded off, with only one discal cell; three middle cells, the first of which is small, and four terminal cells, no transverse vein on clavus, membranal appendix rather broad; wings at apices narrowly rounded; venation as in *Thamnotettix*.—MATSUMURA, cited by DISTANT, loc. cit.

NEPHOTETTIX APICALIS Motschulsky.

Nephotettix apicalis MOTSCHULSKY (*Pediopsis*), Etud. Ent. (1859) 110; MELICHAR, Hom. Fauna Ceylon (1903) 193; Wiener Ent. Zeit. **24** (1905) 303; MATSUMURA, Trans. Sapporo Nat. Hist. Soc. **1** (1905) 20; DISTANT, Fauna Brit. Ind. Rhynch. **4** (1908) 360–362, fig. 229; MATSUMURA, Insek. Zuckerrohr Formosa **2** (1910) 1; MELICHAR, Notes Leyd. Mus. **36** (1914) 133; FLETCHER, Proc. Soc. Ent. Mut. Pusa (1918) 177; DAMMERMAN, Landbouwdierk Oöst Ind. (1919) 170; FLETCHER, Proc. Third Ent. Meet. Pusa **1** (1920) 275.

Pediopsis nigromaculata MOTSCHULSKY, Etud. Ent. (1859) 111; MATSUMURA, Termész. Füzetek **25** (1902) 379.

Thamnotettix nigropicta STÅL, Öfv. Vet.-Akad. Förh. (1870) 740; ATKINSON, Journ. As. Soc. Bengal **57** (1889) 338; KIRBY, Journ. Linn. Soc. Zool. **25** (1891) 137.

Selenocephalus cincticeps UHLER, Proc. U. S. Nat. Mus. **19** (1896) 292.

Nephotettix nigropicta KIRKALDY, Rep. Exp. Sta. Haw. Sugar Planters' Assoc. pt. 9 (1906) 333; Exp. Sta. Haw. Sugar Planters' Assoc. Bull. **3** (1907) 54.

[76] Fauna Brit. Ind. Rhynch. **4** (1908) 359–360, fig. 228.

Length, including tegmina, about 4 millimeters.

Vertex greenish virescent with black upper margin, upper half of frons, lora, and middle of gena black; upper and middle part of clypeus with a black stripe, in some the entire face black; a black, somewhat elongated, spot on the middle before claval suture and lower third of tegmina; sternum and abdomen including pygofer more or less black, in some only black middle markings on each segment. In some almost wholly black, posterior oral tarsi with black markings. Head as broad as pronotum, vertex slightly broader than distance from middle to eyes. Last ventral segment somewhat rounded.

Nephotettix apicalis has no definite zoöcentric region. It is found in India, Ceylon, and all of the East Indies as far as the Philippines and Formosa. It is recorded in South and East Africa. In the Philippines this insect is one of the worst pests of rice. Occasionally it appears in great numbers during the later part of the rainy season and attacks young rice until the plants in several hundreds of hectares of paddies are completely destroyed. It is controlled effectively by the use of light traps.

NEPHOTETTIX BIPUNCTATUS Fabricius.

Nephotettix bipunctatus FABRICIUS (*Cicada*), Syst. Rhyng. (1803) 78; STÅL (*Thamnotettix*), Hem. Fabr. 2 (1869) 82; ATKINSON, Journ. As. Soc. Bengal 54 (1885) 111; MATSUMURA (*Nephotettix*), Termész. Füzetek 25 (1902) 379; DISTANT, Fauna Brit. Ind. Rhynch. 4 (1908) 359–360, fig. 228; FLETCHER, Proc. Second Ent. Meet. Pusa (1918) 176; Proc. Third Ent. Meet. Pusa 1 (1920) 275.

Length, including tegmina, about 4 to 4.5 millimeters.

Vertex slightly broader than distance from middle to eye. Margin of vertex slightly convex anteriorly and depressed; entire dorsal side of body yellowish green, except the triangular patch starting from extreme edge of clavus on commissural line to both sides of tegmina, which is pale brown; from head to tip of ovipositor pale yellow and spotless, except prosternum which has a black marking on each side under each femur, and middle lower extremity of last abdominal segment.

The coloration of the males of *Nephotettix apicalis* and *N. bipunctatus* figured by Distant[77] are the complete black face of *apicalis*, whereas that of *bipunctatus* is black only on the basal parts of the frons and the lora; the absence of the arcuated marginal fascia on the vertex which is found in *apicalis;* the black on the pectus and venter are more intensified in *bipunc-*

[77] Tom. cit. 359–361, figs. 228, 229.

tatus, the face completely black in the latter species. The middle tegminal marking is only partially black, semilunar in *bipunctatus*, and not in the form of oblique long lines as in *apicalis*. The black apical markings of *bipunctatus* are not as intense as those of *apicalis*.

Nephotettix bipunctatus is here reported for the first time from the Philippines; previously known from Calcutta.

As to this leafhopper being an important potential pest, I shall quote Annandale's information to Distant:[78]

> . . . in Calcutta this species appears in enormous swarms in the air at night about the end of the rains (generally in October). Gas-lamps in the street have to be protected against the green fly, as it is called, to prevent the light being put out by the numbers the dash into it. I have known over three pounds weight of dead "green flies" and other insects to be swept up under a couple of electric lamps in one morning.

In the Philippines this species is a more persistent pest of rice than *N. apicalis*.

Genus EUTETTIX Van Duzee

Eutettix VAN DUZEE, Psyche 6 (1892) 307; MATSUMURA, Termész. Füzetek 25 (1902) 380; KIRKALDY, Exp. Sta. Haw. Sugar Planters' Assoc. Bull. 1 (1906) 331; Bull. 3 (1907) 53; DISTANT, Fauna Brit. Ind. Rhynch. 4 (1908) 362; DELONG, Tenn. St. Bd. Ent. Bull. 17 (1916) 65.

Type, *E. lurida* Van Duzee.
Distribution: World-wide.

Intermediate in its characters between *Thamnotettix* and *Athysanus*. In form the species resembles *Phlepsius*, being broader and stouter than in *Thamnotettix*. The vertex is rounded anteriorly and more or less transversely impressed behind the apex; the front is nearly as wide as in *Athysanus;* the elytra are proportionately shorter than in *Thamnotettix*, and moderately valvate at the apex, with one transverse nervure between the first and second sectors. The sides of the pronotum are shorter than in *Thamnotettix* and ecarinate.—VAN DUZEE, cited by DISTANT, loc. cit.

EUTETTIX DISCIGUTTUS (Walker).

Eutettix disciguttus WALKER (*Acocephala*), Journ. Linn. Soc. Zool. 1 (1857) 172; SIGNORET (*Bythoscopus*), Ann. Soc. Ent. Fr. (1879) 88; MATSUMURA, Trans. Sapporo Nat. Hist. Soc. 1 (1905) 20; DISTANT, Fauna Brit. Ind. Rhynch. 4 (1908) 362–363, fig. 320; MELICHAR, Notes Leyd. Mus. 36 (1913) 133, Java.

Thamnotettix sellata UHLER, Proc. U. S. Nat. Mus. 19 (1896) 294; MATSUMURA (*Eutettix*), Termész. Füzetek 25 (1902) 381; MELICHAR, Hom. Faun. Ceylon (1903) 189; Wiener Ent. Zeit. 24 (1905)

[78] Tom. cit. 359–360.

302; KIRKALDY, Exp. Sta. Haw. Sugar Planters' Assoc. Bull. 1 pt. 9 (1906) 331.

Eutettix sellatus OSHANIN, Ann. Mus. Zool. St. Peters. 11 (1906) 140; MATSUMURA, Journ. Coll. Agr. Sapporo 5 (1914) 190.

Female, length, including tegmina, 4 millimeters.

Vertex greenish yellow, somewhat angularly produced, one-third anterior surface reflexed, tinged grayish with two close light brown spots, below them on the vertex two almost indiscernible yellowish green markings; last half of vertex medially, longitudinally divided by a groove; two fuscous spots, one each between the eyes and median suture; eyes fuscous; face pale white; pronotum transverse, one and one-half times as long as vertex, sordid green to dark gray, marked with irregular fuscous spots; scutellum yellowish green, small, about one and one-half times as broad as long, the third upper lateral side with a fuscous spot, and a dark brown line between transverse sulca and marginal angle of apex; tegmina milky white, with greenish and fuscous spots all over, concentrating at tips; venation light brown; venter and legs pale, last ventral segment centrally sinuated.

Distribution: Throughout the Malayan Archipelago, Queensland, Japan, East Africa. Hitherto not recorded from the Philippines.

LUZON, Rizal Province, Alabang.

EUTETTIX MARQUEZI sp. nov.

Female, length, about 3.75 millimeters.

Vertex depressed, slightly longer than half the distance between eyes, median longitudinal suture not complete, light brown specks between this suture and eyes, two black spots on anterior border, frons ochraceous with darkened area on each side; clypeus wider at apex than at base; pronotum transverse, somewhat stramineous, smooth with irregular dark brown markings; twice as long as vertex; scutellum subtriangular, wider than long, anterior half almost completely brown, posterior angle ochraceous with brown markings at center; tegmina light brown, with light areas on middle and posterior parts, profusely and irregularly marked with fuscous, two longitudinal dark blotches on middle of claval area, and two on middle of corium, two distinct black spots on center of preinterior apical cells and two fuscous markings on innermost apical cells; venter dirty ochraceous, wing veins fuscous.

LUZON, Laguna Province, Mount Banahao (*J. Valdez;* type in my collection).

This species is named for Mr. Severo Marquez, my assistant in plant-pest control work in the Bureau of Plant Industry, Manila.

EUTETTIX BASILANUS sp. nov.

Male, length, including tegmina, 4.5 millimeters; female, 5.

Vertex greenish ochraceous with one fuscous arcuated band on margin of vertex, and one fuscous transverse band connecting eyes, one spot at inner side of eye just above anterior margin of vertex; face, frons, and antennæ ochraceous, the rest of face fuscous; pronotum finely striated and punctured, greenish ochraceous with dirty brownish patch on each of lateral sides; scutellum greenish ochraceous, with an olive-brown patch on each side of upper lateral angles; tegmina olive-brown, wide veins brown with dark spots on inner and outer claval veins, on vein of commissural suture, on claval suture, at tip of tegmina, veins between first and second apical cells, and on costal and discal areas, sometimes these blotches of the costal and discal are absent; body beneath wings and pectoral region fuscous; venter yellowish ochraceous with longitudinal median fuscous line.

MINDANAO, Zamboanga. BASILAN (type and paratypes, Baker collection, U. S. N. M.).

EUTETTIX MORISMUS sp. nov.

Female, length, including tegmina, 5.5 millimeters; male, 5.

Almost as small as *E. basilanus* but more slender and tapering, vertex dark ochraceous with chocolate-brown markings; pronotum dark greenish ochraceous, greatly and roughly striated; profusely marked with fuscous markings, twice as long as vertex and one and one-third as long as scutellum; scutellum yellowish ochraceous; claval region and middle portion clear to tip brown, with fuscous markings, at tip of tegmina three equidistant spots on commissural region, and some of veins, principally on the half posterior part; body beneath, face, pectus, abdomen, and legs greenish ochraceous.

MINDANAO, Zamboanga. BASILAN (types and paratypes, Baker collection, U. S. N. M.).

Division CICADULARIA

This division of the Cicadellidæ is characterized (according to Van Duzee as cited by Distant[79]) by the obsolete or nearly obsolete outer fork, the outer branch of the first sector of the

[79] Tom. cit. 366.

elytra, and the well-rounded vertex, the middle of which is a little longer than the width between the eyes.

There are five species described in this paper belonging to this division; one in the genus *Balclutha* Kirkaldy, one in *Cicadula* Zetterstedt, and five in *Agellus* De Long and Davidson.

The following key, partly adopted from Distant,[80] is formulated for the separation of these three genera:

Key to the Philippine genera of the division Cicadularia.

a[1]. First two sectors of the wings coalescing before the apex, the resulting nervure uniting with the costa some distance before the tip of the wing, thus forming but two apical areoles............ *Balclutha* Kirkaldy.

a[2]. First two sectors of the wings united for a greater or less distance but soon again separating and attaining the apex of the wing, thus forming three apical areoles.. *Cicadula* Zett.

a[3]. The upper and lower cubital branches uniting on the middle of the tegmina, then separating and reuniting before the apical area, thus forming four apical areoles.................... *Agellus* DeLong and Davidson.

Genus BALCLUTHA Kirkaldy

Gnathodus FIEBER, Verh. Zool.-Bot. Ges. Wien 16 (1866) 504.
Balclutha KIRKALDY, Entomologist 33 (1900) 243, nom. nov.; DISTANT, Fauna Brit. Ind. Rhynch. 4 (1908) 368.

Type, *B. punctata* Thunberg, universally distributed.

Body oblong, obtuse in front, much narrowed behind. Crown very short, about one-fourth as long as pronotum, scarcely longer in the middle than at the sides. Elytra much longer than the abdomen, overlapping at the apex; outer branch of the cubital nerve obsolete; membrane very large, as long as inner margin of clavus; appendix large. Submarginal wing-nerve complete; upper branch of the second wing-nerve confluent with the first, and running into the submarginal nerve as one nerve; third wing nerve joined to the lower branch of the second by a transverse nerve.

—EDWARDS, cited by DISTANT, loc. cit.

BALCLUTHA GRAMINEA sp. nov.

Female, length, including tegmina, about 3.25 millimeters.

Whole body green, with some yellowish green tinge. Vertex slightly angulate, about one-half as long as breadth between eyes; ocelli profusely green; eyes partly piceous, the rest fuscous; face almost as broad as long, unmarked; pronotum transverse, almost two and one-half times as long as vertex, slightly arcuate in front and laterally somewhat rounded, almost truncate; behind almost truncate; scutellum fairly large, triangular, almost as long as pronotum, smooth, with triangular semihyaline markings

[80] Loc. cit.

on each of the basal angles, with an impressed transverse line one-third the distance from apical angle; tegmina somewhat broad on middle, narrowed behind, hyaline towards apex; venation dark green, except that of the apex which is semitransparent white; pectus above and beneath green; abdomen above and beneath yellowish green. Near *B. viridis* Matsumura.

LUZON, Manila (*F. Q. Otanes*, holotype in my collection).

Genus CICADULA Zetterstedt

Cicadula ZETTERSTEDT, Ins. Lapp. (1838) 296.
Macrosteles FIEBER, Verh. Zool.-Bot. Ges. Wien **16** (1866) 504.
Thamnus FIEBER, Verh. Zool.-Bot. Ges. Wien **16** (1866) 505.
Limnotettix SAHLBERG, Cicad. (1871) 224.

Type, *C. variata* Fall, a Palæarctic species, world-wide in distribution.

Cicadula is differentiated from *Balclutha* by having the first two sectors of the wings united for a greater or less distance but soon again separating, thus forming three apical cells, instead of coalescing before the apex, with the resulting union of the nervure with the costa, forming only two apical cells as in *Balclutha*.

CICADULA AREVALOI sp. nov.

Female, length, including tegmina, 3.25 millimeters.

Light greenish yellow, vertex distinctly marked with two black dots near posterior margin slightly nearer to eyes than to each other, two triangular fuscous marks on apex of vertex near eyes, connecting with faint marginal line; inner third of eyes piceous, the rest fuscous; frons striated with fuscous transverse striæ; pronotum with anterior third greenish yellow, the rest dark gray, slightly transverse, anterior and lateral sides rounded, posterior margin almost truncate; scutellum yellowish with two large acute triangular black markings on each lateral angle with distinct incomplete transverse groove equilateral; tegmina smoky hyaline, venation milky white, the outer posterior veins tinged with brownish; body black; ventral segments and pygofer pale yellow; ovipositor black; legs, especially the last tibia, thickly spinuled.

MINDANAO, Occidental Misamis Province, Oroquieta (*P. S. Soriano*, type in my collection).

This species is named in honor of Isaias Arevalo, of the Bureau of Plant Industry, in recognition of his long and efficient service in the plant-pest and disease-control division.

Genus AGELLUS DeLong and Davidson

Agellus DeLong and Davidson, BAKER, Invertebrata Pacifica 1 (1903) 1 (*Eugnathodus*) wrong det.; DELONG and DAVIDSON, Ohio Journ. Sci. 33 (1933).

Type, *A. neglecta* DeLong and Davidson.

Distribution: Idaho, Arizona, Texas, Nebraska, Georgia, Florida, and Colorado, in the United States; Luzon, Negros, Mindanao, and Cebu, in the Philippines. Probably of wider distribution.

Agellus was proposed by DeLong and Davidson for *Eugnathodus* which Baker erected in 1903, citing a wrong species as type. Although the description was correctly based upon the species that Baker apparently had in mind when he described the genus *Eugnathodus,* the type specimens proved to belong to a species of *Balclutha.* Therefore, *Eugnathodus* Baker required a new name, according to opinions 14 and 16 of the International Code of Zoölogical Nomenclature. *Agellus* is closely allied to *Balclutha* and *Cicadula,* but differs in the following characteristics:

Vertex broadly rounded, slightly broader than pronotum, anterior and posterior margins almost parallel, lateral posterior angle not wider than vertex. In *Balclutha,* inner sector of tegmina not forked, two anteapical cells produced. In *Cicadula,* these first two sectors of wings united, but separated at a certain distance and reaching apex of wing, thus forming three apical areoles. In *Agellus* the upper and lower cubital branches unite, separate, re-unite, and separate again, forming four apical cells.

This genus is placed in the division Cicadularia, tribe Macrotelini, the species of which have a shorter vertex, usually rounded. The ædeagus, according to DeLong and Davidson,[81] bears dorsal and basal protruding processes, while in *Balclutha* the basal portion is enlarged and may extend dorsally but without finger-like processes.

A few specimens from the Philippines have been examined and compared with some of the type specimens of DeLong and Davidson at the Ohio State University. The generic characteristics of *Agellus* were those of these specimens, more so because the genitalia of one of them proved to be identical with the genitalia of *Agellus neglecta,* the type species of this genus. A few new species of *Agellus* are here described.

[81] Ohio Journ. Sci. 33 (1933).

In 1906 Kirkaldy[82] described specimens of leafhoppers collected by Koebele and Perkins from the Viti Isles of the Fiji group, for which he erected the genus *Nesosteles,* the type species being *N. hebe.* In his description Kirkaldy did not give enough detail to make his genus easily recognizable. He merely stated, "allied to *Macroteles* but radial is not obsolescent and the wing venation is different." Then he continued to describe his species by merely giving the coloration and size of the insect. The description, however, is accompanied by a sketch of wing venation through which his genus may be placed.

I have examined the type specimen of this genus (*Nesosteles*), in the United States National Museum, and it seems that *Agellus* and *Nesosteles* are the same thing. However, because of lack of specimens for the study of the genitalia and the wing venation I do not venture to unite them.

AGELLUS NEGLECTA DeLong and Davidson.

Eugnathodus abdominalis BAKER, Invertebrata Pacifica 1 (1903) 1.
Agellus neglecta DELONG and DAVIDSON (*Eugnathodus*), Ohio Journ. Sci. 33 (1933) 55–56.

Male, length, about 3 millimeters.

Vertex rounded, one-fourth as long as distance between eyes, median longitudinal groove grayish brown, two dark spots below ocelli; ocelli ochraceous at apex; frons rectangular, margined by green stripes and transversely striated by brown striæ; clypeus narrow, rectangular; cheek and lora pale ochraceous; eyes blood red; pronotum transverse, twice as long as vertex, rounded anteriorly, truncate at posterior end, grayish with four longitudinal brownish bands and one darker, grayish, longitudinal, median band; scutellum small, dark gray, with a longitudinal median band of darker gray and two brownish spots on lateral angles; tegmina smoky hyaline with milky-white venation; pectus and dorsum, as well as dorsal part of abdomen, dark; venter greenish, with dark markings; legs pale green, except forelegs, which are brownish.

LUZON, Manila.

Distribution: Widely distributed in the United States. It is here reported from the Philippines for the first time.

AGELLUS RUFOFASCIATUS sp. nov.

Female, length, including tegmina, 4 millimeters.

Vertex pale yellow, about one-fourth as long as broad, rounded in front, with a median, longitudinal suture; ocelli red, on apex

[82] Exp. Sta. Haw. Sugar Planters' Assoc. Bull. 1 pt. 9 (1906).

of vertex near eyes; eyes rufous; frons broad, slightly broader than long, triangular, tapering towards clypeus and confluent with vertex; clypeus narrow, rectangular; cheek greatly impressed under antennæ between eyes and carinate edge of frons; pronotum slightly broader than long, about four times as long as vertex and about twice length of scutellum, rounded at base and truncate at posterior margin, pale ochraceous; scutellum orange-yellow with pale yellow tinge in apical angle; visible bristles at base of second segment of antennæ. Tegmina milky white, with hyaline veins and rufous to crimson-red, longitudinal, parallel fascia within cells and tegminal areas; body beneath with fuscous markings; pygofer milky white, thickly bristled, ovipositor pink; last ventral segment medially notched.

LUZON, Rizal Province, Alabang (*J. Valdez*, holotype in my collection; paratypes, Baker collection, U. S. N. M.).

AGELLUS PHILIPPINENSIS sp. nov.

Male, length, including tegmina, 4 millimeters.

Vertex pale ochraceous, two amber-colored spots at base near eyes, short median carina dividing vertex, which is three times as broad between eyes as long; ocelli hyaline, in margin of vertex near eyes; eyes blood red; frons oval, almost twice as long as wide; lower half of clypeus sordid, rectangular, loræ small, distinctly tumid, cheeks shiny yellow, impressed, fuscosordid; pronotum pale ochraceous, slightly transverse, about three times as long as vertex, rounded in front and on sides, hind margin almost truncate, three parallel, longitudinal, orange lines on center and six orange spots between these lines and sides near anterior margin; scutellum pale ochraceous, with yellow markings on each of three angles; tegmina long, with all cells or areas tinged with orange-fuscous, except appendix and two inner apical cells which are milky white; body beneath, pectus, and legs ochraceous; venter pale ochraceous, except last ventral segment and genital sclerites, which are ochraceous; pygofer profusely bristled.

This species is similar to *A. rufofasciatus*, but the external genitalia are clearly different. The last ventral segment of the female in this species is broadly notched at the center, while that of *rufofasciatus* is slightly notched. The coloration also is different. *Agellus rufofasciatus* has alternating white cells; tegmina pinkish red and wing veins hyaline, while in *philippinensis* the cells are light orange and the veins distinctly milky white.

NEGROS, Occidental Negros Province, La Carlota (*C. T. Buligan,* type and paratypes in my collection).

AGELLUS BIFASCIATUS sp. nov.

Female, length, including tegmina, about 2.3 millimeters.

Very small species, yellowish green, vertex rounded, slightly obtuse on middle, about as long as width between eyes, apex green; face without any marking, almost as long as width between eyes; eyes fuscous; pronotum about twice as long as vertex, anteriorly and laterally rounded, posteriorly truncate, a greenish brown tinge on margin of each basal angle; scutellum triangular, as long as broad, upper half dark gray, apical half yellow; tegmina with reddish brown fascia on each side from upper claval area down to margin, first two apical cells and partly first two subapical cells tinged with reddish brown; body beneath, pectus, and legs pale green, abdomen above dark green, underneath the lateral sclerites yellow, rest of abdomen and genitalia green, entire clavus dark.

The name *bifasciatus* is derived from the two rainbowlike longitudinal fasciæ on the tegmina.

LUZON, Manila (*F. Q. Otanes,* holotype in my collection; paratypes, Baker collection, U. S. N. M.).

AGELLUS BISINUATUS (DeLong).

Agellus bisinuatus DELONG (*Eugnathodus*), Journ. Porto Rico 7 (1923) 266–267.

Male, length, including tegmina, 3 millimeters.

Body elongate, pale green, without any marking; vertex very short and roundly produced, about one-fourth as long as broad, green, frons yellowish green, genæ and loræ pale green; pronotum yellowish green, rounded in front and almost truncate at apex, appearing like a semicircle, about as long as broad; scutellum a yellowish equilateral triangle, about half as long as pronotum; tegmina pale greenish hyaline, with white veins; body underneath uniformly pale green. The female is more or less dirty pale yellowish beneath; ocelli on margin of vertex near eyes rufous.

LUZON, Manila. MINDANAO, Occidental Misamis Province, Oroquieta. CEBU. MINDORO. NEGROS.

Widely distributed in the United States and West Indies. It was collected in large numbers from mango shoots and from grasses. This species is here reported from the Philippines for the first time.

Division DELTOCEPHALUSARIA

In this division the leafhoppers are mostly very small, with the vertex more or less angularly produced in front of the eyes, and as long as, or longer than, the distance between the eyes.

The genera *Scaphoideus, Deltocephalus,* and *Xestocephalus* were studied. Distant [83] placed *Xestocephalus* independently under Athysanusaria with no reason other than that its taxonomic position has not been definitely settled.

Key to the Philippine genera of the division Deltocephalusaria.

a [1]. Face much longer than breadth between eyes, scutellum large, as long as pronotum or slightly longer................................ *Scaphoideus* Uhler.

a [2]. Face much longer than breadth between eyes, scutellum small, shorter than pronotum .... *Xestocephalus* Van Duzee.

a [3]. Face scarcely longer than breadth between eyes. *Deltocephalus* Burmeister.

Genus SCAPHOIDEUS Uhler

Scaphoideus UHLER, Trans. Maryland Acad. Sci. (1888) 33; PROVANCHER, Pet. Faune. Ent. Can. 3 (1889) 276; VAN DUZEE, Trans. Am. Ent. Soc. 19 (1892) 299; OSBORN, Journ. Cinc. Soc. Nat. Hist. 19 (1900) 187 (monograph); MATSUMURA, Termész. Füzetek 25 (1902) 383; MELICHAR, Hom. Fauna Ceylon (1903) 194; DISTANT, Fauna Brit. Ind. Rhynch. 4 (1908) 371–372; OSBORN, Ohio Nat. 11 (1911) 249.

Type, *S. immistus* (Say).

Distribution: Nearctic, Palæarctic, Ethiopian, Oriental, Malayan, and Australasian Regions.

Head triangular, flat above, vertex almost as long as the width between the eyes, subacuminate at tip, the base deeply sinuated; front longer than wide, deltoid, with the sides near the tip moderately curved, tylus liguliform; cheeks broad, curved, expanded to behind the middle of the eye, acutely tapering at tip and hardly enclosing the entire lora, the lora diagonal, acute at each end; antennæ long and slender; pronotum sublunate, more curved anteriorly than sinuated posteriorly; wing-covers moderately narrow, longer than the abdomen, curved, valvate, the costal areole long, narrow, destitute of cross-veins, followed by a gradually widening cell, beyond this are four apical cells of large size and mostly broad triangular figure; wings with the two apical middle areoles long and narrowing at base towards the cross-vein; abdomen moderately long and narrow.—UHLER, quoted by DISTANT, loc. cit.

SCAPHOIDEUS MOROSUS Melichar.

Scaphoideus morosus MELICHAR, Hom. Fauna Ceylon (1903) 197, pl. 5, fig. 14, *a–d;* DISTANT, Fauna Brit. Ind. Rhynch. 4 (1908) 373–374.

[83] Fauna Brit. Ind. Rhynch. 4 (1908) 348.

Female, length, including tegmina, 4.75 millimeters.

Vertex, pronotum and scutellum pale greyish white; vertex with a subapical transverse line and a broad fascia between the eyes brownish testaceous; pronotum with four longitudinal testaceous fasciæ (in the specimen figured by Melichar there is an additional fascia on each side); scutellum with three longitudinal fasciæ with dark margins, the two lateral fasciæ darker, shorter, and posteriorly angulated; body beneath and legs pale greyish ochraceous; face with two anterior transversely angulated testaceous lines; posterior tibiæ spotted with piceous tegmina pale greyish white, the veins more or less testaceous, three dark obliquely transverse lines on posterior half of coastal area, a piceous spot preceded by a smaller white spot in central apical cell.—DISTANT, loc. cit.

Originally known from Calcutta, Ceylon, Peradeniya, Point de Galle, Henaratgoda, Colombo.

LUZON, Rizal Province, Alabang (*J. Valdez*).

This species is here reported from the Philippines for the first time.

Genus DELTOCEPHALUS Burmeister

Deltocephalus BURMEISTER, Gen. Ins. 1 subg. 3 (1838); FLOR, Rhyn. Livland. 11 (1861) 221, 223; FIEBER, Verh. Zool.-Bot. Ges. Wien 16 (1866) 506; EDWARDS, Tr., Ent. Soc. London (1888) 33, 42; VAN DUZEE, Trans. Aus. Ent. Soc. 19 (1892) 299; OSBORN and BALL, Iowa Acad. Sci. 4 (1897) 195; MELICHAR, Hom. Fauna Ceylon (1903) 199; DISTANT, Fauna Brit. Ind. Rhynch. 4 (1908) 380; DELONG, Ohio State Univ. Stu. 2 (1926); OSBORN, Ohio Biol. Sur. 3 (1928) 269.

Type, *D. pulicarius* (Fallven), a Palæarctic species.

Distribution probably universal.

According to Distant,[84] Melichar differentiates this genus as follows:

Vertex pointed or obtusely angularly produced; face symmetrically hexagonal; pronotum broader than long; tegmina longer or slightly shorter than the abdomen, rounded off behind, with distinct veins usually bordered with brown to black; in the clavus a distinct transverse vein running from the outer claval vein to the claval suture.

DELTOCEPHALUS DORSALIS Motschulsky.

Deltocephalus dorsalis MOTSCHULSKY, Etud. Ent. (1859) 114; MELICHAR, Hom. Fauna Ceylon (1903) 200, pl. 5, fig. 13, *a–d;* OSHANIN, Ann. Mus. Zool. St. Peters. 11 (1906) 133; DISTANT, Fauna Brit. Ind. Rhynch. 4 (1908) 380–381, fig. 239; MATSUMURA, Insekten Zuckerrohrs Formosa (1910) 20; Journ. Coll. Agr. Sapporo 5 (1914) 213; DISTANT, Fauna Brit. Ind. Rhynch. 7 (1918).

Deltocephalus fulguralis MATSUMURA, Termész. Füzetek 15 (1902) 391.

[84] Tom. cit. 380.

Length, including tegmina, 3.5 millimeters.

Vertex, body beneath and legs pale ochraceous; with two obscure spots at the transverse depression and two smaller ones near base; pronotum and scutellum greyish; pronotum with some very obscure darker longitudinal shadings; scutellum with a dark spot near each basal angle; coxæ and abdomen beneath with some dark spots; tegmina greyish, with an irregular broad oblique fuscous fascia commencing near base and continued to claval apex, its margins are deeply notched or obtusely angulate and enclose a central pale spot on claval sutures, from apex of clavus there is an oblique series of fuscous-brown spots and the apical cells are margined with the same colour, beyond middle of costal margin is a linear dark spot and there are paler fuscous streaks between the veins and on base of claval area; face with obscure dark striations and pale central spot at base.—DISTANT, Fauna Frit. Ind. Rhynch. 4 (1908) 380–381.

Originally known in Bengal, Dacca, Calcutta, Ceylon, Yatiyantota, Peradeniya, Henaratgoda, Colombo, Tenasserim, Myitta, Borneo, and Japan.

LUZON, Rizal Province, Alabang (*J. Valdez*).

This species is reported from the Philippines for the first time.

Genus XESTOCEPHALUS Van Duzee

Xestocephalus VAN DUZEE, Trans. Am. Ent. Soc. 19 (1892) 298; MATSUMURA, Termész. Füzetek 25 (1902) 402; MELICHAR, Hom. Fauna Ceylon (1903) 205; DISTANT, Fauna Brit. Ind. Rhynch. 4 (1908) 348.

Type, *X. pulicarius* VAN DUZEE, a Nearctic species.

Distribution: Nearctic, eastern Palæarctic, Ethiopian, and Oriental Regions.

Vertex tumid, rounded over the front, the ocelli placed on the rounded apex between the eyes, almost the same distance from the eyes as from each other; pronotum transverse, somewhat wider than head; body elongate, slightly narrower at pronotum than middle dorsal section of wings; tegmina without an appendix with five apical and three anteapical cells.

XESTOCEPHALUS OSBORNI sp. nov.

Length, including tegmina, 4.25 millimeters.

Head very much narrower than the pronotum, vertex produced before, with the apex subacute, rounded above, and smooth; frons rather broad at base, twice as long as wide; pronotum rounded, slightly produced in front, transverse, about twice as broad as long, more or less semilunar in shape, anterior margin truncate; scutellum triangularly transverse, about one and one-third times as wide as long; tegmina broad, tapering, posterior

lateral margin folded in, having the appearance of *Makilingia* Baker or *Kolla* Distant, but the broadness of the notal and anterior half of the body dorsal regions resembles that of *Hecalus* Stål; body beneath amber ochraceous; last ventral segment truncate, with a slight notch at posterior margin; pygofer long, slender, profusely bristled; ochraceous to amber, vertex ochraceous with amber mark on lateral sides; ocelli very small, placed on anterior edge of vertex, equidistant to each other as to the eyes; eyes fuscous, large, face almost rounded, amber; pectus, venter, and legs concolorus with face, slightly fuscous spot at base of each tibial spur and spinules of posterior legs; pronotum with two dark amber spots at anterior margin just below eyes, ochraceous; scutellum amber, with six short, longitudinal, ochraceous lines at center; tegmina ochraceous, sparsely strewn with fuscous markings, prominent of which are one at posterior apical angle of clavus, one at third posterior margin, and another at apex of tegmina.

LUZON, Mountain Province, Mount Polis (holotype, Osborn collection; type, Baker collection, U. S. N. M.).

This species is named in honor of Prof. Herbert Osborn, a great teacher and entomologist, and owner of the type specimen.

XESTOCEPHALUS MAQUILINGENSIS sp. nov.

Female, about 2.25 millimeters.

A small species similar to *X. pulicarius* Van Duzee and *X. guttatus* Motschulsky though slightly smaller and with slightly darker markings than either.

Vertex ochraceous with cross piceous markings near apex, a faint brown median line and four faint brown markings at base (two on each side of median line); frons castaneous, obtusely rounded, with four pale spots in arcuate arrangement on level with eye and two similar spots just above front clypeal suture; pronotum brown, longer than vertex, transverse, with two parallel rows of pale markings, anterior intercalated by fuscous markings; vertex dark ochraceous, with a black semitriangular spot in basal angles, and between them five almost confluent pale dots; tegmina short and rounded anteriorly, brown, with pale transparent spots scattered all over; the three on posterior last half of costal area large, first spot (on middle of costal region of tegmina) milky white; pectus ochraceous; venter purplish brown and spinulose.

LUZON, Laguna Province, Mount Maquiling (type, Baker collection, U. S. N. M.).

Division PARALIMNUSARIA

Distant[85] gives the following characteristics of the hoppers under this division:

Vertex somewhat subacutely produced in front of eyes, about or nearly twice as broad between eyes as long; ocelli on the anterior margin very near the eyes.

Genus ALITURALIS novum

Aliturus DISTANT (preoccupied), Fauna Brit. Ind. Rhynch. 4 (1908) 398.

Type, *A. gardineri* Distant.

This monotypic genus was erected by Distant for specimens taken from the Laccadive Archipelago to which he gave the name *Aliturus gardineri.* However, Distant's generic name is preoccupied by *Aliturus* Fairmaire,[86] a genus of beetles.

Vertex broad, depressed, angularly rounded in front, foveately impressed on each side between eyes, which are large and obliquely cover the anterior angles of the pronotum; ocelli indistinct, near anterior margin and near eyes; face globose, strongly narrowed to clypeus, which is slender and a little more than half the length of face, cheeks rounded; pronotum transverse, longer than vertex, lateral margins nearly straight, anterior margin convex, posterior margin subtruncate; scutellum broad, subtriangular, lateral margins shorter than breadth of basal margin, transversely impressed near middle; legs somewhat slender, posterior tibiæ longly spinulose; tegmina opaque, longer than abdomen, veins imperfectly visible. —DISTANT, loc. cit.

ALITURALIS ALABANGENSIS sp. nov.

Female, length, including tegmina, 4.5 millimeters.

Uniformly dark fuscous, vertex broad, depressed, rounded, slightly angularly produced in front, slightly foveately impressed on each side of eyes, these being indistinctly and finely wrinkled, smooth at the center, anterior margin banded with a dark fuscous, almost black fascia; ocelli stramineous, on the anterior margin near the eyes, and connected by a narrow stramineous band; face globose, strongly narrowed towards the apex; clypeus small, slender, loræ rounded; frons tumid with an ochraceous band at the base abruptly tapering towards the clypeus; cheek broad at base, narrow pieces connecting with the clypeus; pronotum transverse, longer than vertex, slightly rounded anteriorly, truncate at base between eyes; slightly, broadly sinuate at posterior margin, posterior half slightly depressed and faintly

[85] Tom. cit. 395. [86] Ann. Soc. Ent. Fr. 71 (1902) 386.

striate; scutellum subtriangular, slightly broader than long, posterior angle separated by a broadly arcuated suture, two-thirds posterior, profusely, faintly punctured, four ochraceous spots on the lateral sides; tegmina longer than abdomen, six pale ochraceous on the inner margin of clavus close to commissural suture, one at basal area, three at suprabrachial, one at the costal, and eight others on apical and anteapical cells.

LUZON, Rizal Province, Alabang (*J. Valdez,* type and holotype in my collection).

TYPHLOCYBINÆ

Members of this subfamily as described by its author "are readily separated from all the other subfamilies of the Jassidae by the four longitudinal veins defining the apical cells without branching, so that there are no anteapical cells, and also by the absence of supernumerary cells in the wings (Gillette). Tegmina usually without appendix." (Distant.[87])

Division EMPOASCARIA

Sectors of posterior wings ending in marginal vein; no anteapical cells, venation most simple in the whole family; generally very small cicadellids, rarely over 4 millimeters long, including tegmina; pronotum as long as vertex or longer, except in *Homa* in which it is shorter than vertex.

Genus EMPOASCA Walsh

Empoasca WALSH, Proc. Bost. Soc. Nat. Hist. 9 (1864) 316.
Chloroneura WALSH, Proc. Bost. Soc. Nat. Hist. 9 (1864) 316.
Chloria FIEBER, Verh. Zool.-Bot. Ges. Wien (1866) 508, pl. 7, fig. 25.
Kybos FIEBER, Verh. Zool.-Bot. Ges. Wien (1866) 508, pl. 7, fig. 26.
Chlorita FIEBER, Rev. Mag. Zool. III 3 (1875) 414.
Cicadula KIRKALDY, Exp. Sta. Haw. Sugar Planters' Assoc. Bull. 1 pt. 9 (1906) 357.

The recognition of species belonging to this genus is practically dependent on the wing venation. The species are small and "usually green, sometimes yellow, red or smoky black. Ocelli present, elytra without appendix, wings with marginal vein, one apical cell. Genital valve in male wanting." (Osborn.[88])

EMPOASCA NIGROPUNCTATA sp. nov.

Very small species, about 2 millimeters long, including tegmina; vertex obtusely angularly produced, almost as long as

[87] Fauna Brit. Ind. Rhynch. 4 (1908) 399.
[88] Ohio Biol. Sur. 3 (1928) 345.

broad between eyes, yellowish green, with two black spots on vertex near apex, temple and upper part of frons yellow, the rest greenish yellow, narrowly striated with fuscous lines; clypeus piceous; ocelli not quite visible, amber-colored; pronotum twice as long as vertex, roundly produced, terminal angle almost truncate, slightly broadly sinuate; yellowish green, with dark gray tinge on center; scutellum concolorous with head and pronotum, small, without markings; tegmina hyaline, with smoky veins; body beneath piceous, legs pale green.

LUZON, Manila: Rizal Province, Alabang (*J. Valdez,* holotype in my collection).

CHECK LIST OF THE PHILIPPINE CICADELLIDÆ WITH THE ORIGINAL BIBLIOGRAPHY AND SYNONYMY*

Family CICADELLIDÆ

Subfamily I. LEDRINÆ

Petalocephala Stål.

**Petalocephala cultellifera* WALKER, List Hom. 3 (1851) 823; Journ. Linn. Soc. Zool. 1 (1856) 98 (*Ledra*); MELICHAR, Hom. Fauna Ceylon (1903) 143 (*Ledropsis*).

Petalocephala conica WALKER, List Hom. 3 (1851) 823; DISTANT, Fauna Brit. Ind. Rhynch. 4 (1908) 164.

Petalocephala punctatissima STÅL, Öfv. Vet.-Akad. Förh. 27 (1870) 732.

Petalocephala philippina STÅL, Öfv. Vet.-Akad. Förh. 27 (1870) 732.

Ledra Fabricius.

Ledra gibba WALKER, List Hom. Ins. 3 (1851) 811.

Ledra lævis WALKER, List Hom. Ins. 3 (1851) 827.

Ledra unicolor WALKER, List Hom. Ins. 3 (1851) 819.

Subfamily II. BYTHOSCOPINÆ

Macropsis Lewis.

Macropsis breakeyi sp. nov.

Macropsis rizali sp. nov.

Macropsis benguetensis sp. nov.

Macropsis fuscovenosa sp. nov.

Macropsis fuscopunctata sp. nov.

Macropsis otanesi sp. nov.

Macropsis basilana sp. nov.

Macropsis dapitana sp. nov.

Macropsis davaoensis sp. nov.

* In the preparation of this check list, I am most indebted to the unpublished notes of the late Charles Fuller Baker, deposited in the United States National Museum. I found the notes after this list was already prepared from available literature and new species described in this paper. Many names were added to my list from Baker's notes. An asterisk before a name indicates that the species is here first recorded as Philippine.

Idiocerus Lewis.

Idiocerus clypealis LETHIERRY, Journ. As. Soc. Bengal 57 (1889) 252; BAKER, Philip. Journ. Sci. § D 10 (1915) 339 (*Idioscopus*).

Idiocerus nacreatus BAKER, Philip. Journ. Sci. § D 10 (1915) 342.

Idiocerinus Baker.

Idiocerinus melichari BAKER, Philip. Journ. Sci. § D 10 (1915) 341–342.

Idiocerinus bakeri sp. nov.

Idioscopus Baker.

Idioscopus palawanensis BAKER, Philip. Journ. Sci. § D 10 (1915) 338–339.

Idioscopus tagalicus BAKER, Philip. Journ. Sci. § D 10 (1915) 340–341.

Iposcopus Baker.

Iposcopus breviceps BAKER, Philip. Journ. Sci. § D 10 (1915) 322.

Iposcopus distanti BAKER, Philip. Journ. Sci. § D 10 (1915) 321–322.

Ipocerus Baker.

Ipocerus kirkaldyi BAKER, Philip. Journ. Sci. § D 10 (1915) 323–324.

Balocha Distant.

Balocha busonioides BAKER, Philip. Journ. Sci. § D 10 (1915) 330.

Bythoscopus Germar.

**Bythoscopus chlorophanus* MELICHAR, Hom. Fauna Ceylon (1903) 153.

Bythoscopus maculipennis STÅL, Öfv. Vet.-Akad. Förh. 27 (1870) 740 (*Macropsis*).

Bythoscopus testaceus sp. nov.

**Bythoscopus rubrofrontalis* DISTANT, Fauna Brit. Ind. Rhynch. 4 (1908) 209, fig. 125.

Chunra Walker.

Chunra niveosparsa LETHIERRY, Journ. As. Soc. Bengal 58 (1889) 252 (*Idiocerus*); MELICHAR, Hom. Fauna Ceylon (1903) 143 (*I. basalis*); BAKER, Philip. Journ. Sci. § D 10 (1915) 325 (*Chunra*).

Chunra niveosparsa Lethierry var. *lagunensis* BAKER, Philip. Journ. Sci. § D 10 (1915) 326.

Chunra niveosparsa Lethierry var. *palawanensis* BAKER, Philip. Journ. Sci. § D 10 (1915) 326.

Chunra niveosparsa Lethierry var. *philippinensis* BAKER, Philip. Journ. Sci. § D 10 (1915) 325–326.

Busonia Distant.

Busonia mindanaoensis BAKER, Philip. Journ. Sci. § D 10 (1915) 328.

Busonia scutellaris BAKER, Philip. Journ. Sci. § D 10 (1915) 327.

Pedioscopus Kirkaldy.

Pedioscopus augustatus BAKER, Philip. Journ. Sci. § D 10 (1915) 335–336.

Pedioscopus coloratus BAKER, Philip. Journ. Sci. § D 10 (1915) 338.

Pedioscopus coloratus var. *bicoloratus,* BAKER, Philip. Journ. Sci. § D 10 (1915) 338.

Pedioscopus coloratus var. *mindanaoensis* BAKER, Philip. Journ. Sci. § D 10 (1915) 337.

Pedioscopus disjunctus BAKER, Philip. Journ. Sci. § D 10 (1915) 331.

Pedioscopus maquilingensis BAKER, Philip. Journ. Sci. § D 10 (1915) 333–334.

Pedioscopus modestus BAKER, Philip. Journ. Sci. § D 10 (1915) 333.

Pedioscopus similis BAKER, Philip. Journ. Sci. § D 10 (1915) 334–335.
Pedioscopus simplex BAKER, Philip. Journ. Sci. § D 10 (1915) 336.

Subfamily III. TETTIGONIELLINÆ

Cicadella (*Tettigonia*) (*Tettigoniella*) Latreille.

Cicadella argyrops SIGNORET, Ann. Soc. Ent. Fr. (1853) 678 (*Tettigonia*).

Cicadella bipunctifrons STÅL, Öfv. Vet.-Akad. Förh. 27 (1870) 733–734 (*Tettigonia*).

Cicadella differentialis BAKER, Philip. Journ. Sci. § D 9 (1914) 420 (*Tettigoniella*).

Cicadella ferruginea FABRICIUS, Ent. Syah. 4 (1794) 32 (*Cicada*); GERMAR, Mag. Ent. 4 (1821) 69 (*Tettigonia*); WALKER, List Hom. Ins. 3 (1851) 736 (*T. confinis*); 737 (*T. addita*); 737 (*T. gemina*); 738 (*T. obscura*); 738 (*T. duplex*); 739 (*T. reducta*); 740 (*T. immaculata*); STÅL, Öfv. Vet.-Akad. Förh. 27 (1870) 733 (*T. impressipennis*); DISTANT, Fauna Brit. Ind. Rhynch. 4 (1908) 202–203 (*Tettigoniella*).

Cicadella impudica SIGNORET, Ann. Soc. Ent. Fr. III 1 (1853) 677 (*Tettigonia*).

Cicadella longa WALKER, List Hom. Ins. 3 (1851) 740 (*Tettigonia*). China determines this species (Baker collection) as distinct from *C. ferruginea*.

Cicadella maquilingensis BAKER, Philip. Journ. Sci. § D 9 (1914) 419, fig. 10 (*Tettigoniella*).

Cicadella norma SIGNORET, Ann. Soc. Ent. Fr. (1853) 671 (*Tettigonia*).

Cicadella philippina WALKER, List Hom. Ins. 3 (1851) 740 (*Tettigonia*).

Cicadella quinquepunctata STÅL, Öfv. Vet.-Akad. Förh. 27 (1870) 734, fig. 137 (*Tettigonia quinquenotata*); BANKS, Philip. Journ. Sci. § D 5 (1910) 52 (*Kolla tripunctifrons*).

Cicadella spectra DISTANT, nom. nov., Fauna Brit. Ind. Rhynch. 4 (1908) 211–212 (*Tettigoniella spectra*); WALKER, List Hom. 3 (1851) 767 (*Tettigonia albida*); STÅL, Öfv. Vet.-Akad. Förh. 27 (1870) 735 (*T. nigrilinea*).

Cicadella spectra DISTANT var. *nigrilinea* STÅL, Öfv. Vet.-Akad. Förh. 27 (1870) 735 (*Tettigonia*).

Cicadella subvirescens STÅL, Öfv. Vet.-Akad. Förh. 27 (1870) 734 (*Tettigonia*); DISTANT, Fauna Brit. Ind. Rhynch. 4 (1908) 212.

Cicadella suturella STÅL, Öfv. Vet.-Akad. Förh. 5 (1855) (*Tettigonia*).

Cicadella nigrifasciata sp. nov.

Cicadella tagalica STÅL, Öfv. Vet.-Akad. Förh. 27 (1870) 734 (*Tettigonia*); BAKER, Philip. Journ. Sci. § D 10 (1915) 196 (*Tettigoniella*).

Cicadella titonii SIGNORET, Ann. Soc. Ent. Fr. (1855) 783 (*Tettigonia*).

Cicadella alticola sp. nov.

Cicadella unimaculata SIGNORET, Ann. Soc. Ent. Fr. (1854) 25 (*Tettigonia*); WALKER, List Hom. Suppl. (1858) 219 (*T. paullula*); STÅL, Freg. Eug. Resa Ins. (1859) 258 (*T. kingbergi*); WALKER, Journ.

Linn. Soc. Lond. Zool. 10 (1869) 304 (*T. igniceps*); DISTANT, Fauna Brit. Ind. Rhynch. 4 (1908) 224 (*Tettigoniella*) (*Kolla*).

Cicadella whiteheadi DISTANT, Fauna Brit. Ind. Rhynch. 4 (1908) 142 (*Tettigoniella*).

Kolla Distant.

Kolla tripunctifrons BANKS, Philip. Journ. Sci. § 5 (1910) 51.

Signoretia Stål.

Signoretia malaya STÅL, Öfv. Vet.-Akad. Förh. (1855) 192 (*Thamnotettix*); Freg. Eug. Resa Ins. (1865) 290 (*Signoretia*).

Signoretia tagalica BAKER, Philip. Journ. Sci. § D 10 (1915) 196.

Signoretia carinata BAKER, Philip. Journ. Sci. 23 (1923) 358.

Signoretia benguetensis BAKER, Philip. Journ. Sci. 23 (1923) 359.

Preta Distant.

Preta luzonensis BAKER, Philip. Journ. Sci. 23 (1923) 361–362.

Mileewa Distant.

Mileewa luzonica BAKER, Philip. Journ. Sci. § D 9 (1914) 415.

Mileewa luzonica var. *decolorata* BAKER, Philip. Journ. Sci. § D 9 (1914) 416.

Ujna Distant.

Ujna philippinensis BAKER, Philip. Journ. Sci. § D 9 (1914) 416.

Makilingia Baker.

Makilingia banahaoensis BAKER, Philip. Journ. Sci. 24 (1924) 64.

Makilingia colorata BAKER, Philip. Journ. Sci. § D 9 (1914) 413.

Makilingia costalis BAKER, Philip. Journ. Sci. 24 (1924) 69.

Makilingia flavifrons MELICHAR, Wiener Ent. Zeit. 40 (1923) 119; BAKER, Philip. Journ. Sci. 24 (1924) 67 (*M. bimaculata*).

Makilingia frontalis BAKER, Philip. Journ. Sci. 24 (1924) 69–70.

Makilingia haightiana BAKER, Philip. Journ. Sci. 24 (1924) 65.

Makilingia intermedia MELICHAR, Wiener Ent. Zeit. 40 (1923) 119; BAKER, Philip. Journ. Sci. 24 (1924) 159 (*variabilis*).

Makilingia intermedia var. *bakeri* MELICHAR, Wiener Ent. Zeit. 40 (1923) 120.

Makilingia intermedia var. *simillima* BAKER, Philip. Journ. Sci. 24 (1924) 63–64.

Makilingia intermedia var. *suturalis* MELICHAR, Wiener Ent. Zeit. 40 (1923) 119; BAKER, Philip. Journ. Sci. 27 (1925) 159.

Makilingia lineata BAKER, Philip. Journ. Sci. 24 (1924) 65.

Makilingia maculata BAKER, Philip. Journ. Sci. § D 9 (1914) 413.

Makilingia nigra BAKER, Philip. Journ. Sci. § D 9 (1914) 409.

Makilingia pallida BAKER, Philip. Journ. Sci. § D 9 (1914) 414.

Makilingia panayensis BAKER, Philip. Journ. Sci. 24 (1924) 66.

Makilingia pruinosa BAKER, Philip. Journ. Sci. § D 9 (1914) 412.

Makilingia sibuyanensis BAKER, Philip. Journ. Sci. 24 (1924) 62.

Makilingia speciosa BAKER, Philip. Journ. Sci. 24 (1924) 61.

Makilingia surigaoensis BAKER, Philip. Journ. Sci. 24 (1924) 66.

Subfamily IV. GYPONINÆ

Division 1. PENTHIMARIA

Penthimia Germar.

Penthimia albiguttula STÅL, Öfv. Vet.-Akad. Förh. 27 (1870) 737.

Penthimia reticulata STÅL, Öfv. Vet.-Akad. Förh. 27 (1870) 737.

Penthimia erebus STÅL, Öfv. Vet.-Akad. Förh. 27 (1870) 737.
Penthimia hemifuscata sp. nov.
Thaumatoscopus Kirkaldy.
Thaumatoscopus roxasi sp. nov.
Thaumatoscopus reflexus STÅL, Öfv. Vet.-Akal. Förh. 27 (1870) 738.
Neodartus Melichar.
**Neodartus acocephaloides* MELICHAR, Hom. Fauna Ceylon (1903) 163.
Vulturnus Kirkaldy.
Vulturnus reticulatus STÅL, Öfv. Vet.-Akad. Förh. 27 (1870) 737.

Division 2. HYLICARIA

Pythamus Melichar.
Pythamus melichari BAKER, Philip. Journ. Sci. § D 10 (1915) 198.
Pythamus melichari var. *mindanaoensis* BAKER, Philip. Journn. Sci. § D 10 (1915) 200.

Subfamily V. JASSINÆ (including ACOCEPHALINÆ)

Division 1. HECALUSARIA

Hecalus Stål.
Hecalus thomsonii STÅL, Öfv. Vet.-Akad. Förh. 27 (1870) 737.
Hecalus gramineus sp. nov.
Hecalus florii STÅL, Öfv. Vet.-Akad. Förh. 27 (1870) 736.
**Hecalus capitatus* DISTANT, Fauna Brit. Ind. Rhynch. 7 (1918) 30.
Hecalus wallengrenii STÅL, Öfv. Vet.-Akad. Förh. 27 (1870) 736.
Thomsoniella Signoret.
**Thomsoniella albomaculata* DISTANT, Fauna Brit. Ind. Rhynch. 4 (1908) 280–281.
Thomsoniella porrecta WALKER, List Hom. Suppl. (1858) 262 (*acocephalus*); MOTSCHULSKY, Etud. Ent. 8 (1859) (*Platymetopius lineolatus*); STÅL, Öfv. Vet.-Akad. Förh. 27 (1870) 737 (*Hecalus kirschbaumii*); SIGNORET, Ann. Soc. Ent. Fr. (1880) 52 (*Thomsoniella*); ATKINSON, Journ. As. Soc. Bengal 54 (1885) 104 (*Thomsonia*); DISTANT, Fauna Brit. Ind. Rhynch. 7 (1918) 31 (*Parabolocratus*).
Nirvana Kirkaldy.
Nirvana placida STÅL, Freg. Eug. Resa Ins. (1859) 295 (*Jassus*); MELICHAR, Hom. Ceylon (1903) 160 (*N. pallida*).
Nirvana philippinensis BAKER, Philip. Journ. Sci. 23 (1923) 385.
Ophiuchus Distant.
Ophiuchus basilanus BAKER, Philip. Journ. Sci. 23 (1923) 394.
Ophiuchus montanus BAKER, Philip. Journ. Sci. 23 (1923) 395.
Kana Distant.
Kana anomala BAKER, Philip. Journ. Sci. 23 (1923) 385.
Kana maculata BAKER, Philip. Journ. Sci. 23 (1923) 382.
Kana picea BAKER, Philip. Journ. Sci. 23 (1923) 383.
Jassonirvana Baker.
Jassonirvana lineata BAKER, Philip. Journ. Sci. 23 (1923) 399–400.
Pseudonirvana Baker.
Pseudonirvana davaoensis BAKER, Philip. Journ. Sci. 23 (1923) 39.
Pseudonirvana davaoensis var. *luzonensis* BAKER, Philip. Journ. Sci. 23 (1923) 392.

Pseudonirvana sanguinolineata BAKER, Philip. Journ. Sci. 23 (1923) 392–393.

Stenometopius Matsumura.

Stenometopius mindanaoensis BAKER, Philip. Journ. Sci. 23 (1923) 400–401.

Division 2. SELENOCEPHALARIA

Paramesus Fieber.

**Paramesus lineaticollis* DISTANT, Fauna Brit. Ind. Rhynch. 4 (1908) 294, fig. 186.

Krisna Kirkaldy.

Krisna strigicollis SPINOLA, Mem. de Matem. e di Fis. Ital. Modena (1852) 167 (*Siva*); WALKER, List Hom. 3 (1851) 847 (*Acocephalus stramineus*); Journ. Linn. Soc. Zool. 1 (1857) 173 (*Bythoscopus testaceous*); List Hom. Suppl. (1858) 266 (*B. indicatus*); STÅL, Freg. Eug. Resa Ins. (1859) 290 (*Selenocephalus costalis*); Ann. Soc. Ent. Fr. (1864) 66 (*Siva*); SIGNORET, Ann. Soc. Ent. Fr. (1879) 88 (*Acocephalus stramineus*); ATKINSON, Journ. As. Soc. Bengal 54 (1885) 108 (*Siva strigicollis*); DISTANT, Fauna Brit. Ind. Rhynch. 4 (1908) 297–298 (*Krisna*).

**Krisna striata* KIRBY, Journ. Linn. Soc. Zool. 24 (1891) 171 (*Gypona*); KIRKALDY, Entomologist 33 (1900) 294 (*kirbyi*); 34 (1901) 39 (*Eogypona kirbyi*); MELICHAR, Hom. Fauna Ceylon (1903) 167 (*Siva*); DISTANT, Fauna Brit. Ind. Rhynch. 4 (1908) 298 (*Krisna striata*).

Roxasella gen. nov.

Roxasella camusi sp. nov.

Roxasella losbañosa sp. nov.

Omanella gen. nov.

Omanella barberi sp. nov.

Omanella philippina sp. nov.

Omanella johnsoni sp. nov.

Parabolocratus Uhler.

**Parabolocratus gutattus* UHLER, Proc. U. S. Nat. Mus. 19 (1896) 291–292 (*Parabolocratus*) (in Baker collection); MATSUMURA, Coll. Agr. Hokuku Imp. Univ. Pub. 4 (1912) (*Parabolopona*); 6,000 Illustrated Insects of Japan-Empire (1931) (*Parabolopona*).

Division 3. TARTESSUSARIA

Tartessus Stål.

Tartessus ferrugineus WALKER, List Hom. 3 (1851) 865 (*Bythoscopus*); STÅL, Freg. Eug. Resa Ins. (1859) 290 (*B. malayus, biarcatus, unilineatus, unifascia* Walker, MS.); Öfv. Vet.-Akad. Förh. (1865) 165 (*Tartessus malayus*); 27 (1870) 738 (*T. ferrugineus*).

Tartessus malayus STÅL, Freg. Eug. Resa Ins. (1859) 290.

Tartessus fieberi STÅL, Öfv. Vet.-Akad. Förh. (1865) 156.

Gessius Distant.

Gessius malayensis var. *mindanaoensis* BAKER, Philip. Journ. Sci. 15 (1919) 217.

Drabescus Stål.

Drabescus conspicous DISTANT, Fauna Brit. Ind. Rhynch. 4 (1908) 306 (in Baker collection).

Drabescus remotus WALKER, Cat. Hom. 3 (1851) 866.
Drabescus stramineus DISTANT, Fauna Brit. Ind. Rhynch. 4 (1908) 306–307 (in Baker collection).

Tylissus Stål.
Tylissus nitens STÅL, Öfv. Vet.-Akad. Förh. 27 (1870) 739.

Division 4. JASSUSARIA

Jassus Fabricius.
Jassus conspersus STÅL, Öfv. Vet.-Akad. Förh. (1854) 254 (*Coelidia sparsa*); 27 (1870) 735 (*Jassus conspersus*).
Jassus dubia WALKER, List Hom. 3 (1851) 781 (*Tettigonia*); STÅL, Öfv. Vet.-Akad. Förh. (1862) 494 (*Coelidia*); DISTANT, Rec. Ind. Mus. 2 (1908) 150 (*Jassus dubia*).
Jassus elegans DISTANT, Fauna Brit. Ind. Rhynch. 4 (1908) 329.
Jassus obscurus STÅL, Öfv. Vet.-Akad. Förh. 27 (1870) 736.
Jassus philippinensis STÅL, Öfv. Vet.-Akad. Förh. 27 (1870) 736.
Jassus luzonensis BAKER, Philip. Journ. Sci. § D 10 (1915) 56–57.
Jassus sparsus STÅL, Öfv. Vet.-Akad. Förh. (1854) 254.
Jassus mindanaoensis sp. nov.

Tharra Kirkaldy.
Tharra carinata BAKER, Philip. Journ. Sci. § D 10 (1915) 58.

Division 5. ATHYSANUSARIA

Athysanus Burmeister (*Phrynomorphus* Curtis).
Athysanus atkinsoni DISTANT, Fauna Brit. Ind. Rhynch. 4 (1918) 345 (*Athysanus*).
**Athysanus fusconervosus* MOTSCHULSKY, Bull. Soc. Nat. Moscow 36 (1863) 97 (in Baker collection).
**Athysanus indicus* DISTANT, Fauna Brit. Ind. Rhynch. 4 (1908) 344 (in Baker collection).

Stirellus Osborn and Ball.
Stirellus nigripectus sp. nov.

Acocephalus Germar.
Acocephalus olivaceous WALKER, List Hom. 3 (1851) 846.

Xestocephalus Van Duzee.
Xestocephalus osborni sp. nov.
Xestocephalus maquilingensis sp. nov.
**Xestocephalus guttatus* MOTSCHULSKY, Etud. Ent. (1859) 113 (*Deltocephalus*); MATSUMURA, Termész. Füzetek (1902) 25 (*Xestocephalus*) (in Baker collection).
**Xestocephalus pardalinus* DISTANT, Fauna Brit. Ind. 4 (1908) 35 (in Baker collection).

Division 6. THAMNOTETTIXARIA

Nephotettix Matsumura.
**Nephotettix bipunctatus* FABRICIUS, Syst. Rhyng. (1803) 78 (*Cicada*); STÅL, Hem. Fabr. 2 (1869) 82 (*Thamnotettix*); MATSUMURA Termész. Füzetek 25 (1902) 379 (*Nephotettix*).
Nephotettix apicalis MOTSCHULSKY, Etud. Ent. (1859) 110 (*Pediopsis*); UHLER, Proc. U. S. Nat. Mus. 19 (1896) 292 (*Selenocephalus cincticeps*); MATSUMURA, Termész. Füzetek 25 (1902) 379 (*P. nigromaculata*); MELICHAR, Wiener Ent. Zeit. 24 (1905) 305 (*N. apicalis*).

Eutettix Van Duzee.

**Eutettix disciguttus* WALKER, Journ. Linn. Soc. Lond. Zool. 1 (1857) 172 (*Acocephalus*); SIGNORET, Ann. Soc. Ent. Fr. (1879) 88 (*Bythoscopus*); UHLER, Proc. U. S. Nat. Mus. 19 (1896) 244 (*Thamnotettix sellata*); MATSUMURA, Termész. Füzetek 25 (1902) 381 (*Eutettix sellatus*); MELICHAR, Notes Leyd. Mus. 36 (1913) 133.

Eutettix marquezi sp. nov.

Eutettix basilanus sp. nov.

Eutettix morismus sp. nov.

Division 7. CICADULARIA

Cicadula Zett.

Cicadula arevaloi sp. nov.

Balclutha Kirkaldy.

Balclutha graminea sp. nov.

Balclutha olivacea MELICHAR, Wiener Ent. Zeit. 40 (1923) 100.

Agellus DeLong and Davidson.

Agellus bifasciatus sp. nov.

**Agellus neglecta* DELONG and DAVIDSON, Ohio Journ. Sci. 33 (1933) 55–56 (*Eugnathodus*); 33 No. 3 (1933) (*Agellus*).

**Agellus bisinuatus* DELONG, Journ. Dept. Agr. Porto Rico 7 (1933) 266–267.

Agellus philippinensis sp. nov.

Agellus rufofasciatus sp. nov.

Division 8. DELTOCEPHALUSARIA

Deltocephalus Burmeister.

**Deltocephalus dorsalis* MOTSCHULSKY, Etud. Ent. (1859) 114.

**Deltocephalus distinctus* MOTSCHULSKY, Etud. Ent. (1859) 112; MATSUMURA, Termész. Füzetek 25 (1902) 381 (*fulguralis*).

Scaphoideus Uhler.

**Scaphoideus morosus* MELICHAR, Hom. Fauna Ceylon (1903) 197.

Division 9. PARALIMNUSARIA

Alituralis nom. nov. (*Alitururs* Distant).

Alituralis alabangensis sp. nov.

Xestocephalus Van Duzee.

Xestocephalus osborni sp. nov.

Xestocephalus maquilingensis sp. nov.

Subfamily VI. TYPHLOCYBINÆ

Division 1. EMPOASCARIA

Empoasca Walsh.

Empoasca flavescens FABRICIUS, Ent. Syst. 4 (1794) 46 (*Cicada*); MELICHAR, Cicad. Mitt. Europ. (1896) 326 (*Chlorita*); KIRKALDY, Exp. Sta. Haw. Sugar Planters' Assoc. Bull. 9 (1906) 357 (*Cicadula*); DISTANT, Fauna Brit. Ind. Rhynch. 4 (1908) 405 (*Empoasca*); WOODWORTH, Philip. Agric. 10 (1921) 22.

Empoasca nigropunctata sp. nov.

Division 2. TYPHLOCYBARIA

Typhlocyba Germar.

Typhlocyba nigrobilineata MELICHAR, Hom. Ceylon (1903) 218.

Erythroneura Fitch.

**Erythroneura nigrobimaculata* MOTSCHULSKY, Bull. Soc. Nat. Moscow 36 (1863) 101; BAKER, unpublished notes (*Typhlocyba*) (in Baker collection).

Insert after the synonymy on page 334:

Very pale yellow; head short conical above, almost straight along the hind border; face flat on the disk, with indistinct, oblique ridges, on each side; dorsal abdominal segments with a puncture on each side; legs yellowish white; wings white. Length of body 3½ lines; of the wings 7 lines.—WALKER, List Hom. Insects 3 (1853) 767.

ILLUSTRATIONS

PLATE 1

FIG. 1. *Idiocerinus bakeri* sp. nov.; *a*, vertex, pronotum, and scutellum; *b*, front; *c*, male external genitalia.

2. *Macropsis breakeyi* sp. nov.; *a*, vertex, pronotum, and scutellum; *b*, front; *c*, female external genitalia; *d*, male external genitalia.
3. *Macropsis rizali* sp. nov.; *a*, vertex, pronotum, and scutellum; *b*, front; *c*, female external genitalia.
4. *Macropsis benguetensis* sp. nov.; *a*, vertex, pronotum, and scutellum; *b*, front; *c*, female external genitalia; *d*, male external genitalia.
5. *Macropis fusconervosa* sp. nov.; *a*, vertex, pronotum, and scutellum; *b*, front; *c*, female external genitalia; *d*, male external genitalia.
6. *Macropsis fuscopunctata* sp. nov.; *a*, vertex, pronotum, and scutellum; *b*, front; *c*, female external genitalia.
7. *Macropsis luzonensis* sp. nov.; *a*, vertex, pronotum, and scutellum; *b*, front; *c*, female external genitalia; *d*, male external genitalia.
8. *Macropsis basilana* sp. nov.; *a*, vertex, pronotum, and scutellum; *b*, front; *c*, female external genitalia.
9. *Macropsis otanesi* sp. nov.; *a*, vertex, pronotum, and scutellum; *b*, front; *c*, female external genitalia; *d*, male external genitalia.
10. *Macropsis davaoensis* sp. nov.; *a*, vertex, pronotum, and scutellum; *b*, front; *c*, female external genitalia.
11. *Cicadella longa* Walker; front.
12. *Cicadella longa* Walker; *a*, female external genitalia.
13. *Macropsis dapitana* sp. nov.; *a*, vertex, pronotum, and scutellum; *b*, front; *c*, female external genitalia.

PLATE 2

FIG. 1. *Cicadella alticola* sp. nov.; *a*, vertex, pronotum, and scutellum; *b*, front; *c*, female external genitalia.

2. *Penthimia hemifuscata* sp. nov.; *a*, vertex, pronotum, and scutellum; *b*, front; *c*, female external genitalia.
3. *Thaumatoscopus roxasi* sp. nov.; *a*, vertex, pronotum, and scutellum; *b*, front; *c*, male external genitalia.
4. *Hecalus gramineus* sp. nov.; *a*, vertex, pronotum, and scutellum; *b*, front; *c*, lateral view of vertex, pronotum, and scutellum.
5. *Cicadella nigrifasciata* sp. nov.; *a*, vertex, pronotum, and scutellum; *b*, front; *c*, male external genitalia.
6. *Xestocephalus osborni* sp. nov.; *a*, vertex, pronotum, and scutellum; *b*, front; *c*, female external genitalia.
7. *Alituralis alabangensis* sp. nov.; *a*, vertex, pronotum, and scutellum; *b*, front; *c*, female external genitalia.

FIG. 8. *Cicadella suturella* Stål; *a*, vertex, pronotum, and scutellum; *b*, front; *c*, female external genitalia; *d*, male external genitalia.

9. *Xestocephalus maquilingensis* sp. nov.; *a*, vertex, pronotum, and scutellum; *b*, front; *c*, female external genitalia.

10. *Empoasca nigropunctata* sp. nov.; *a*, vertex, pronotum, and scutellum; *b*, front.

PLATE 3

FIG. 1. *Roxasella* gen. nov. *camusi* sp. nov. (type of the genus); *a*, adult; *b*, front; *c*, male external genitalia.

2. *Roxasella losbañosa* sp. nov.; *a*, vertex, pronotum, and scutellum; *b*, front; *c*, female external genitalia; *d*, external male genitalia.

3. *Omanella* gen. nov. *philippina* sp. nov.; *a*, vertex, pronotum, and scutellum; *b*, front; *c*, male external genitalia.

4. *Omanella johnsoni* sp. nov.; *a*, vertex, pronotum, and scutellum; *b*, front; *c*, female external genitalia; *d*, male external genitalia.

5. *Omanella barberi* sp. nov. (type of the genus); *a*, vertex, pronotum, and scutellum; *b*, front; *c*, female external genitalia; *d*, male external genitalia.

6. *Jassus mindanaoensis* sp. nov.; *a*, vertex, pronotum, and scutellum; *b*, front; *c*, last ventral segment of female.

PLATE 4

FIG. 1. *Cicadula arevaloi* sp. nov.; *a*, vertex, pronotum, and scutellum; *b*, front; *c*, female external genitalia.

2. *Stirellus nigripectus* sp. nov.; *a*, vertex, pronotum, and scutellum; *b*, front; *c*, female external genitalia; *d*, male external genitalia.

3. *Eutettix marquezi* sp. nov.; *a*, vertex, pronotum, and scutellum; *b*, front; *c*, female external genitalia.

4. *Agellus rufofasciatus* sp. nov.; *a*, vertex, pronotum, and scutellum; *b*, front; *c*, female external genitalia.

5. *Eutettix morismus* sp. nov.; *a*, vertex, pronotum, and scutellum; *b*, front; *c*, female external genitalia; *d*, male external genitalia.

6. *Eutettix basilanus* sp. nov.; *a*, vertex, pronotum, and scutellum; *b*, front; *c*, female external genitalia; *d*, male external genitalia.

7. *Agellus neglectus* DeLong and Davidson; *a*, vertex, pronotum, and scutellum; *b*, front; *c*, female external genitalia.

8. *Balclutha graminea* sp. nov.; *a*, vertex, pronotum, and scutellum; *b*, front; *c*, female external genitalia.

9. *Agellus bifasciatus* sp. nov.; *a*, vertex, pronotum, and scutellum; *b*, front; *c*, female external genitalia.

10. *Agellus philippinensis* sp. nov.; *a*, vertex, pronotum, and scutellum; *b*, front; *c*, female external genitalia.

11. *Agellus;* tegminal venation.

12. *Agellus neglectus* DeLong and Davidson; internal genitalia.

13. *Agellus bisinuatus* DeLong; *a*, vertex, pronotum, and scutellum; *b*, front; *c*, female external genitalia.

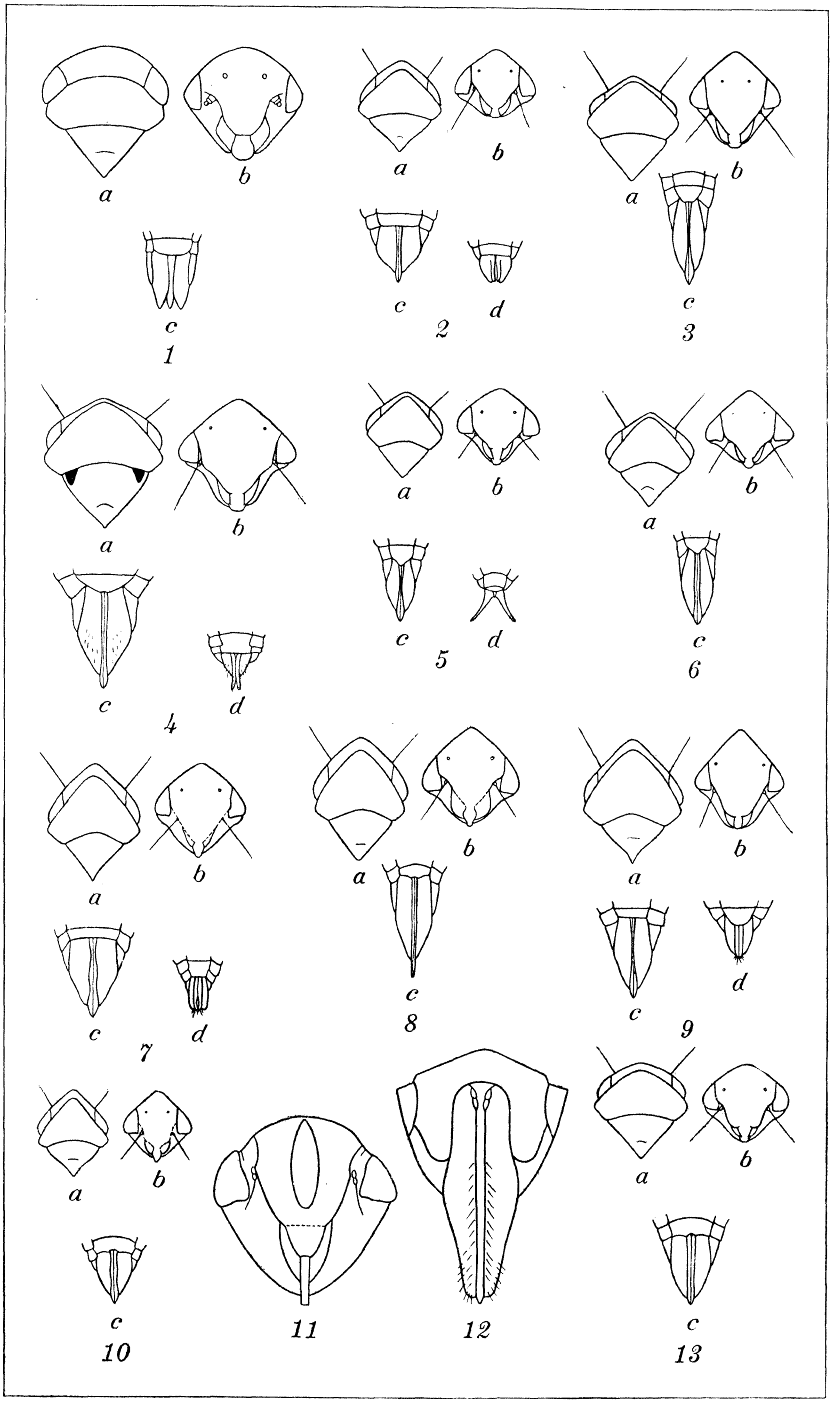

a
b
c
1
a
b
c
d
2
a
b
c
3
a
b
c
d
4
a
b
c
d
5
a
b
c
6
a
b
c
d
7
a
b
c
8
a
b
c
d
9
a
b
c
10
11
12
a
b
c
13

PLATE 1.

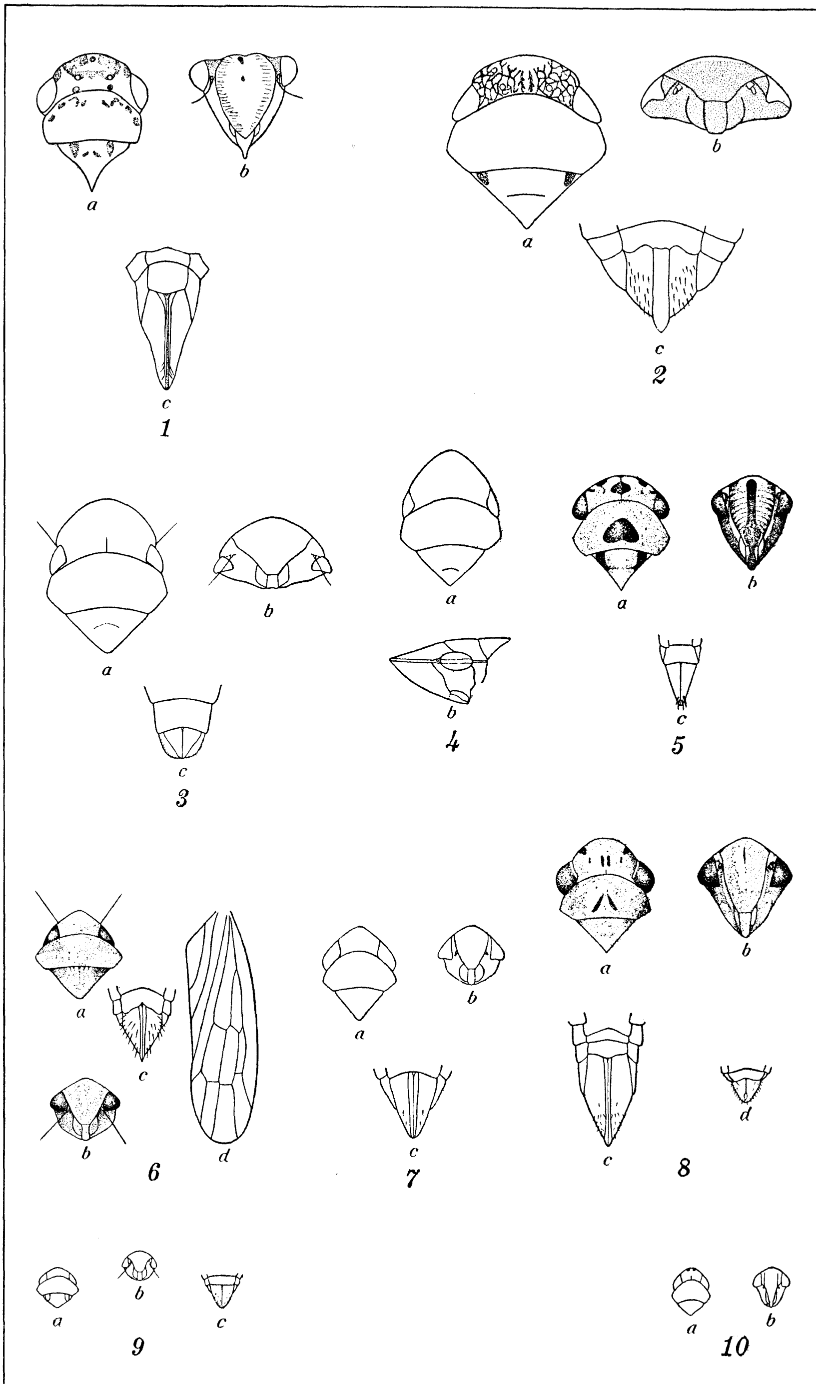


PLATE 2.

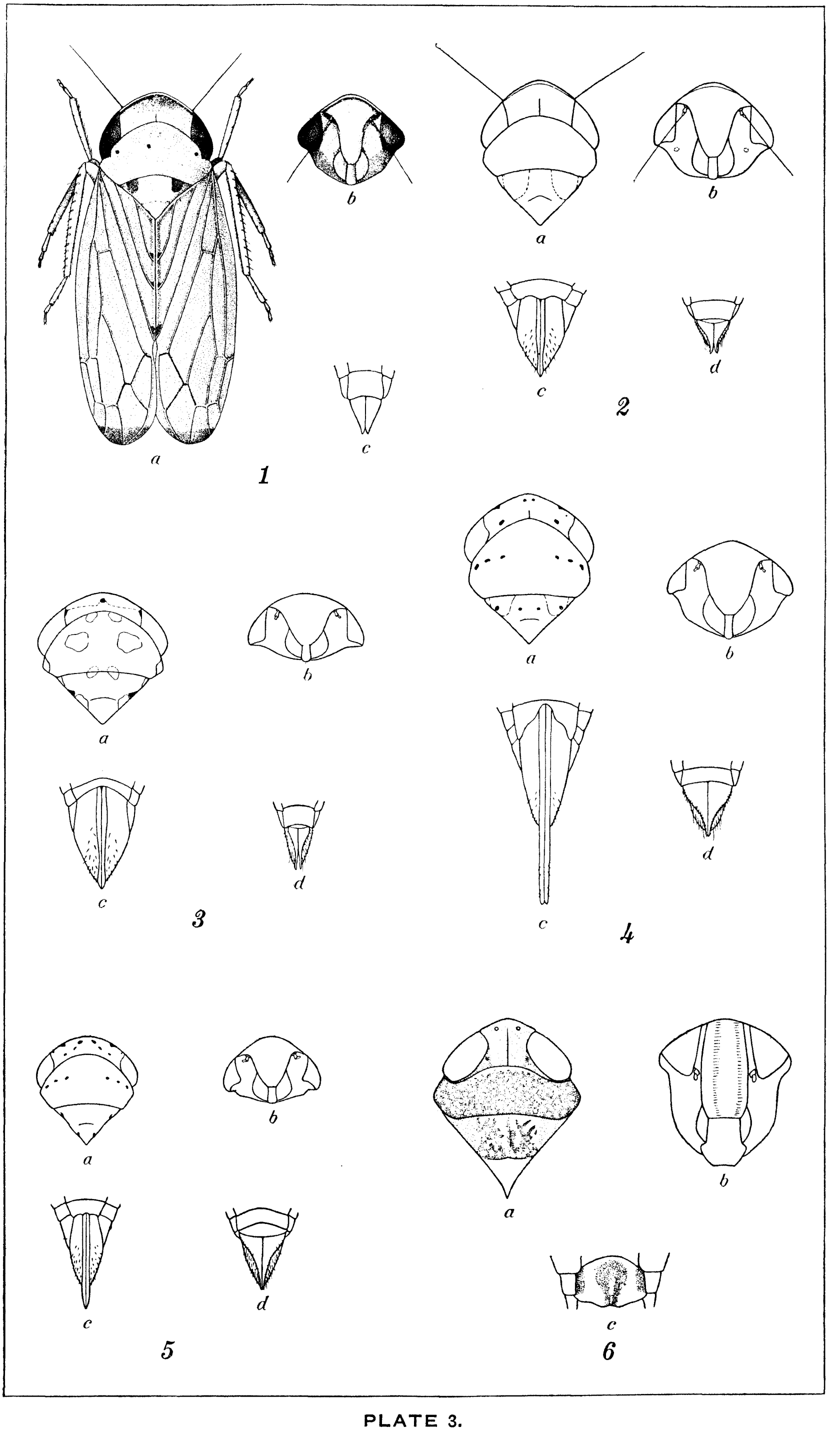


PLATE 3.

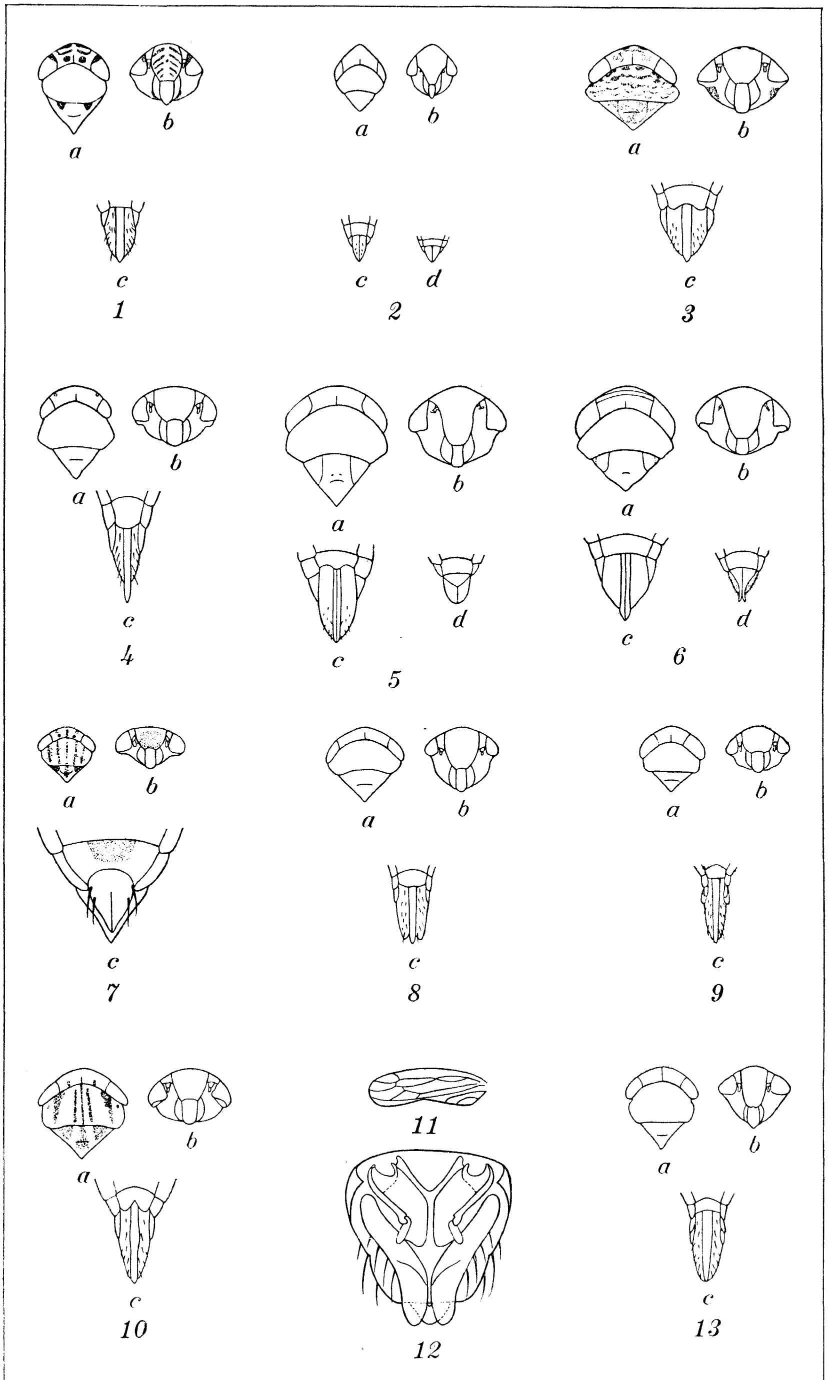

a
b
c
1
a
b
c
d
2
a
b
c
3
a
b
c
4
a
b
c
d
5
a
b
c
d
6
a
b
c
7
a
b
c
8
a
b
c
9
a
b
c
10
11
12
a
b
c
13

PLATE 4.

THE PHILIPPINE JOURNAL OF SCIENCE

VOL. 61 DECEMBER, 1936 No. 4

EXPERIMENTAL STUDIES ON THE CURATIVE TREATMENT OF SURRA IN NATIVE HORSES IN THE PHILIPPINES, II

By LOPE M. YUTUC

Of the College of Veterinary Science, University of the Philippines Manila

The experiments discussed below are a continuation of the investigation on the chemotherapy of surra in Philippine horses, previously published by the writer (1934). Some of the results recorded in that paper demonstrated that naganol given intravenously alone is capable of sterilizing the animal body of surra trypanosomes, provided there is no cerebrospinal involvement. Conversely, it was also shown that when the causative agent has already gained a foothold in the cerebrospinal fluid, the drug fails to effect a cure, due apparently to its lack of power to penetrate the meninges in a concentration deadly to the trypanosome. Rodenwalt and Douwes (1922) and Bubberman, Douwes, and van Bergen (1925) found in their investigations of equine surra in the Dutch East Indies that naganol administered intravenously is likely to effect a cure only in the incipient stage of infection; that is, when clinical symptoms are absent or have just made their appearance, indicating the possibility that the organism has not yet found its way into the nervous system. In recognition of these facts and in view of the present trend of opinion with regard to surra infection, namely, that relapses during the treatment originate mainly from nervous complications, the advantages of the injection of naganol simultaneously into the cerebrospinal canal and into the circulation are not

difficult to appreciate. Moreover, because of the satisfactory results obtained by Edwards (1926) in India from the intrathecal-intravenous treatment of equine surra with naganol alone and later confirmed by Williams (1926), it seems desirable to exploit the possibilities of the treatment in surra as it occurs in the Philippine Archipelago, in spite of the technical difficulties attending its application.

Some of the animals treated by the intrathecal-intravenous method were subsequently subjected to etharsanol-naganol treatment, for reasons that will be noted below.

MATERIALS AND METHODS

The same materials as in the previous experiments were employed in the investigation, but all of the horses were infected experimentally.

PROCEDURE

With the exception of two animals which were infected intrathecally, the horses were infected subcutaneously and treated when the cerebrospinal fluid was positively known to be involved by animal inoculation. The technic employed by Edwards was closely observed. It consisted briefly in casting the animal after the mane in the occipito-atlantal articulation had been clipped close and disinfected with tincture of iodine. With the horse properly secured in a recumbent position, a sterile gauge 16 needle $7\frac{1}{2}$ centimeters long was introduced slowly through the skin and the tissues beneath and directed obliquely following the wing of the atlas. With careful manipulation one would feel and hear a sound similar to the one produced by puncturing a piece of tissue paper with a sharp needle, indicating that the meninges were already perforated. Immediately after, the cerebrospinal fluid dribbled out. With the needle kept in situ, a piece of india-rubber tubing 12 centimeters long and with a bore of 0.3 centimeter was slipped over the butt. After about 15 cubic centimeters of the fluid had oozed out, the free end was engaged to the nozzle of an injection syringe previously filled with naganol solution, the latter being injected subsequently and slowly into the cerebrospinal canal. The syringe was disengaged from the rubber tubing while the latter was firmly pressed with the balls of the index finger and the thumb. The tube was then squeezed towards the needle to drive whatever solution had remained in it into the canal. When this had been accomplished,

the needle was withdrawn and the horse released. Immediately after, the intravenous injection was given.

The dose of naganol for intrathecal injection was 0.045 milligram in 0.1 per cent solution, and for the intravenous injection 15 milligrams in 10 per cent solution per kilogram live body weight, respectively. In general the injections were administered fortnightly until three courses were injected.

As in work previously reported, the simultaneous injections of etharsanol and naganol were employed in the three relapsed animals, observing the same doses and manner of administration.

The complement-fixation test [1] for surra was employed in some of the experimental horses in conjunction with the microscopic examination of the peripheral blood and animal inoculation.

EXPERIMENTS AND RESULTS

To determine the efficiency of the simultaneous intrathecal and intravenous injections of naganol in experimental surra among Philippine horses the following experiments were made.

EXPERIMENT 1. HORSE 67; WEIGHT, 161 KILOGRAMS; A WORN-OUT CASTAWAY CALESA HORSE

January 16, 1934. Inoculated subcutaneously with surra trypanosomes.

January 19. Blood positive (+).

January 20. Blood negative.

January 21. Blood positive (+).

January 22, 23, and 24. Blood positive (++++).

January 25. Blood positive (++++). Animal unable to stand. Given the initial simultaneous treatment of naganol in the doses of 6.7 milligrams in 0.1 per cent concentration for the intrathecal injection and 2.25 grams in 10 per cent solution for the intravenous injection. In the course of the intrathecal injection 6 cubic centimeters of cerebrospinal fluid was obtained and injected immediately into a white rat.

January 26. Animal was found dead; no autopsy made.

February 4. White rat positive (++); died five days later.

EXPERIMENT 2. HORSE 68; WEIGHT, 154 KILOGRAMS

February 7, 1934. Infected subcutaneously with surra blood.

February 13. Blood positive (+).

February 14. Blood positive (++++).

February 15. Blood positive (++).

February 16. Blood positive (+).

February 17 and 18. Blood positive (++).

[1] The author is much indebted to Doctors Topacio and Acevedo, both of the Research Division, Bureau of Animal Industry, for performing the complement-fixation test.

February 19. Blood negative.
February 20. Blood positive (++).
February 21 and 22. Blood positive (++++).
February 23. Blood positive (+++).
February 24 and 25. Blood positive (++).
February 26. Blood positive (+). Animal reweighed (121 kilograms) and subjected to the simultaneous intrathecal and intravenous injections of naganol in the doses of 5.445 milligrams in 0.1 per cent solution for the former and 1.82 grams in 10 per cent solution for the latter. Simultaneously two white rats were inoculated intraperitoneally with 7 cubic centimeters each of the cerebrospinal fluid obtained in the process of intrathecal injection. These laboratory animals became positive later and died.

February 27. Blood negative. Horse depressed, appetite poor and œdema of the muzzle noted. The temperature rose to 40° C.

March 1. Animal improved in condition and its appetite and body temperature returned to normal. A perirectal eruption developed which, however, healed in the course of ten days.

March 16. Blood positive (+). Temperature 39.9° C. Treatment repeated.

March 17. Blood negative. Horse depressed again, temperature rising to 40° C. Two white rats were inoculated with cerebrospinal fluid obtained in the process of treatment; these became positive and died in the course of five days.

March 31. A third treatment given. Two white rats were again secured and infected with the cerebrospinal fluid. These laboratory animals succumbed later to the infective inoculation.

April 14. A fourth course of the intrathecal-intravenous injection given. Two other white rats were simultaneously injected with cerebrospinal fluid. Both laboratory animals caught the infective inoculation and died.

June 9 and 16. Complement-fixation tests positive (++++). Blood negative.

June 23. Cerebrospinal fluid tested for surra trypanosomes by inoculating two white rats. Both escaped infection. Susceptibility test made; rats caught surra and died. Complement-fixation test positive (++++).

June 30 and July 2 and 13. Complement-fixation tests repeated; all positive (++++).

August 19. One hundred twenty-seven days after last injection, blood positive (+).

August 28. Animal died very much emaciated.

EXPERIMENT 3. HORSE 69; WEIGHT, 166 KILOGRAMS

April 9, 1934. Infected subcutaneously with surra organisms.
April 18 and 19. Blood positive (+).
April 20. Blood positive (++++).
April 21. Blood negative.
April 22 and 23. Blood positive (+).
April 24. Blood positive (++).
April 25, 26, 27, 28, and 29. Blood positive (++++).
April 30. Blood negative.
May 1. Blood negative. Horse weighed (149 kilograms) and subjected to intrathecal-intravenous treatment of naganol, getting the same doses as

in the foregoing experiments. Two white rats were given cerebrospinal fluid obtained incidentally to intrathecal injection. Complement-fixation test negative.

May 2. Horse depressed and took food sparingly; with a high temperature. However, this train of symptoms disappeared in the course of time. A perirectal eruption was observed and behaved in much the same manner as in experiment 2. Blood negative.

May 7. Blood of both white rats positive (++).

May 9. One of the white rats died.

May 10. Complement-fixation test negative; other white rat died.

May 15. Treatment repeated.

May 16. Reaction to the treatment less intense.

May 17. Complement-fixation test positive (+).

May 25. Blood positive (+).

May 30. Treated. One white rat given 10 cubic centimeters cerebrospinal fluid obtained in the process of the treatment. Complement-fixation test positive (+++).

June 6. White rat positive (++).

June 7. Complement-fixation test positive (++++).

June 16. White rat died.

June 17. Blood positive (+).

June 18. Blood positive (++). In view of the unfavorable result, the treatment was discontinued.

EXPERIMENT 4. HORSE 70; WEIGHT, 109 KILOGRAMS

April 9, 1934. Inoculated with surra organisms.

April 21. Blood negative. Reinoculated.

April 27. Blood positive (+).

April 28 and 29. Blood positive (++++).

April 30. Blood positive (+++).

May 1. Blood positive (++++). Complement-fixation test positive (+).

May 2. Blood positive (++).

May 3 and 4. Blood negative.

May 5. Blood positive (+).

May 6 and 7. Blood negative.

May 8. Blood not examined.

May 9. Blood positive (++++).

May 10. Blood positive (+). Complement-fixation test negative.

May 11. Blood not examined.

May 12. Blood positive (+). Horse reweighed and tipped the scale at 86 kilograms, a decrease of 23 kilograms. The animal was given simultaneous intrathecal and intravenous injections of naganol in doses of 3.87 milligrams and 1.29 grams, respectively, and in the same concentrations as in the above experiment. At the same time two white rats were given cerebrospinal fluid; each received 8 cubic centimeters, developed surra, and died.

May 13. Blood negative. Animal depressed, with impaired appetite. Temperature 40.2° C.

May 15. Horse found dead. Since the body was still warm to the touch, cerebrospinal fluid was obtained and injected into two other white rats.

Both white rats caught the infective inoculation and died. Close inspection of the animal revealed contusions and bruises on the head indicating that the horse must have developed brain disease.

EXPERIMENT 5. HORSE 71; WEIGHT, 151 KILOGRAMS

September 1, 1934. Inoculated subcutaneously with surra organisms.

September 3 and 6. Complement-fixation tests negative.

September 7. Blood positive (+).

September 8 and 9. Blood positive (++++).

September 10. Blood positive (++++). Complement-fixation test negative.

September 11. Blood positive (+++).

September 12 and 13. Blood positive (+).

September 14. Blood positive (++++).

September 15. Blood positive (++++). Complement-fixation test positive; first tube (+), second tube (++).

September 16. Blood negative.

September 17. Blood negative. Horse subjected to intrathecal-intravenous treatment. At the same time two white rats were inoculated with cerebrospinal fluid, developed surra, and died subsequently.

September 18. Animal depressed with eyes half-closed and eyelids œdematous; muzzle swollen and head pendant. Appetite poor; temperature 40° C. The above symptoms soon disappeared; however, perirectal eruption appeared, and subsided in about ten days.

October 1. Treatment repeated.

October 2. Blood positive (+). Instead of being continued as in experiment 3, the treatment was suspended and the horse was used in the second phase of the work.

EXPERIMENT 6. HORSE 72; WEIGHT, 164 KILOGRAMS

December 30, 1934. Infected intrathecally with surra trypanosomes.

January 3 and 4, 1935. Blood positive (+).

January 5. Blood positive (++++).

January 6. Blood and cerebrospinal fluid positive (++++). Animal reweighed and lost 14 kilograms. Afterwards it was subjected to intrathecal-intravenous injection of naganol, 6.75 milligrams for the intrathecal and 2.25 grams for the intravenous injection in the same concentrations as in the foregoing experiments. Complement-fixation test negative.

January 7. Blood negative.

January 18. Complement-fixation test positive (+++).

January 20. Treatment repeated.

February 1. Complement-fixation test positive (++++).

Februay 3. Given last simultaneous intrathecal-intravenous injection.

March 5. Complement-fixation test positive (+).

April 1. Complement-fixation test positive (++++).

April 30. Blood positive (++). Ten cubic centimeters of blood inoculated into a white rat produced the disease in four days; rat died subsequently. The horse being still strong was used in the second phase of the investigation.

EXPERIMENT 7. HORSE 73; WEIGHT, 141 KILOGRAMS

September 14, 1935. Infected intrathecally with surra trypanosomes.

September 19. Blood positive (++++). Animal depressed; appetite poor.

September 20. Blood positive (++++). Complement-fixation test negative. Horse lethargic; appetite poor.

September 21. Blood positive (++++). Animal lethargic; appetite impaired.

September 22. Blood positive (++++). Temperature rose to 40° C. Condition the same as above. The animal was reweighed and tipped the scale at 131 kilograms. Given first treatment.

September 23. Blood negative. Appetite improved although animal is still depressed. Temperature returned to normal.

September 25. Blood negative. A perirectal eruption noted.

October 6. Blood negative. Treatment repeated. Complement-fixation test negative. Perirectal eruption almost healed; œdema of pendant portion appeared.

October 16. Blood negative. Eruption of the rectum disappeared entirely. Appetite fair; œdema present.

October 20. Blood negative as well as cerebrospinal fluid. Given last injection.

October 31. Blood negative; severe laminitis observed; œdema disappeared.

November 8. Blood negative; laminitis slightly improved.

November 13. Blood negative; animal down, unable to stand, struggling desperately to get up. When helped to its feet, the animal manifested forced movements. In the afternoon it was killed in extremis. Two white rats were given cerebrospinal fluid but failed to develop surra. After a month susceptibility test made. Both came down with the disease and died subsequently.

Experiments 8, 9, and 10 were intended to determine the value of etharsanol-naganol treatment in experimental surra in horses that failed to respond to the intrathecal-intravenous injections.

EXPERIMENT 8. HORSE 69; WEIGHT, 149 KILOGRAMS

June 17, 1934. Relapsed as recorded in experiment 3 in spite of the intrathecal-intravenous treatment of naganol.

June 19. Blood negative. Two white rats inoculated with blood. Both developed surra after seven days and died in the course of five days. Given simultaneous intravenous injections of etharsanol and naganol in doses of 2.24 grams and 1.49 grams in 10 per cent concentration, respectively.

June 20. Blood negative. Complement-fixation test positive (++++).

June 25. Blood negative. Treatment repeated. The dose of naganol reduced to 0.745 gram, the etharsanol remaining the same as in the initial injection.

July 1. Blood negative. Given the third treatment, the same doses as immediately above.

July 3. Blood negative. Complement fixation positive (++++) in three tubes.

August 3. Blood negative. Complement fixation positive; ++++ in the first, +++ in the second, and ++ in the third tube.

August 15. Blood negative. Complement fixation positive; ++++ in the first and second tubes and +++ in the third tube. Animal was gaining in weight (159 kilograms).

September 3. Blood negative. Complement fixation negative.

September 30. Blood negative. Complement fixation negative.

October 16 and November 5. Blood negative. Complement fixation negative.

November 21. Blood negative. Cerebrospinal fluid obtained and injected into two white rats. Both failed to develop surra, hence after thirty days' observation they were inoculated with surra organisms. In five days surra organisms appeared in the tail blood; died four days later.

February 1, 1935. Blood negative. Complement fixation suspicious (±).

April 8 and September 4 and 20, 1935, and February 17, 1936. Blood negative (animal inoculation). Complement fixation negative. Animal weighed 160 kilograms.

August 1. Animal in good condition; weight 191 kilograms.

EXPERIMENT 9. HORSE 71; WEIGHT, 118 KILOGRAMS

October 2, 1934. Relapsed as recorded in experiment 5 after the second intrathecal-intravenous injection of naganol.

October 3. Blood positive (+). Complement fixation ++++ in two tubes. Given the initial treatment of etharsanol-naganol combination, the same doses as in experiment 8.

October 4. Blood negative.

October 9. Blood negative; treatment repeated.

October 16. Blood negative; treatment repeated.

October 30. Blood negative. Complement fixation positive (+).

November 16 and December 4, 1934; February 1 and March 5, 1935; and February 17, 1936. Complement fixation negative. Weight of the horse 157 kilograms; condition good. Animal inoculation negative.

EXPERIMENT 10. HORSE 72; WEIGHT, 137 KILOGRAMS

April 30, 1935. Relapsed as recorded in experiment 6 from the intrathecal-intravenous treatment of naganol. Blood obtained from the horse and injected into a white rat; the latter killed inside of ten days after the first appearance of the trypanosomes in the tail blood.

May 3. Given initial treatment.

May 9 and 16. Blood negative. Treatment repeated on both days.

July 25 and September 4. Blood negative. Complement fixation negative.

September 13. Cerebrospinal fluid obtained and injected into two white rats. Both escaped infection. Susceptibility test made. Rats developed surra and died.

February 17, 1936. Blood negative. Complement-fixation test negative. Horse in good condition.

July 30. Animal in good condition and weighed 163 kilograms. Animal inoculation negative.

For the sake of clarity some of the results of the experiments were condensed and are given in Tables 1 and 2.

TABLE 1.—*Showing some of the results obtained in experiments 1 to 7.*

Experiment No.	Animal No.	Infected.	Incubation period.	Weight of animal.			Treatment.		
				Before infection.	Before treatment.	After relapse.	Date.	Intrathecal.	Intravenous.
			Days.	*kg.*	*kg.*	*kg.*		*mg.*	*g.*
1	67	Jan. 16, 1934	4	161			Jan. 25, 1934	6.70	2.25
2	68	Feb. 7, 1934	7	154	121		Feb. 26, 1934	5.445	1.82
							Mar. 16, 1934	5.445	1.82
							Mar. 31, 1934	5.445	1.82
							Apr. 14, 1934	5.445	1.82
3	69	Apr. 9, 1934	10	166	149	149	May 1, 1934	6.71	2.24
							May 15, 1934	6.71	2.24
							May 30, 1934	6.71	2.24
4	70	Apr. 9 and 21, 1934	7	109	86		May 12, 1934	3.87	1.29
5	71	Sept. 1, 1934	7	151	118	118	Sept. 17, 1934	5.31	1.77
							Oct. 1, 1934	5.31	1.77
6	72	Dec. 30, 1934	5	164	150	137	Jan. 6, 1935	6.75	2.25
							Jan. 20, 1935	6.75	2.25
							Feb. 3, 1935	6.75	2.25
7	73	Sept. 14, 1935	6	141	131		Sept. 22, 1935	5.895	1.97
							Oct. 6, 1935	5.895	1.97
							Oct. 20, 1935	5.895	1.97

TABLE 1.—*Showing some of the results obtained in experiments 1 to 7*—Continued.

Experiment No.	Animal No.	Results.	Remarks.
1	67	Died the day following	This was a worn-out castaway calesa horse, hence very susceptible to surra organisms; cerebrospinal fluid positive as a result of animal inoculation.
2	68	Relapsed Mar. 16 and Aug. 19, 1934; died Aug. 28, 1934	Cerebrospinal fluid positive as a result of animal inoculation.
3	69	Relapsed May 25 and June 17, 1934	June 19, 1934, subjected to etharsanol-naganol treatment; cerebrospinal fluid positive (animal inoculation).
4	70	Died May 15, 1934; cerebrospinal fluid positive for surra trypanosomes.	Cerebrospinal fluid positive as a result of animal inoculation.
5	71	Relapsed Oct. 2, 1934	Oct. 2, 1934, subjected to etharsanol-naganol treatment; cerebrospinal fluid positive (animal inoculation).
6	72	Relapsed Apr. 30, 1935	Infected intrathecally; subjected to etharsanol-naganol treatment May 3, 1935; cerebrospinal fluid positive (microscopic examination).
7	73	Killed in extremis Nov. 13, 1935; surra organisms were not recovered from the cerebrospinal fluid.	Infected intrathecally; cerebrospinal fluid positive by microscopic examination.

TABLE 2.—*Showing some of the results obtained in experiments 8 to 10.*

Experiment No.	Horse No.	Date relapsed from intrathecal-intravenous injections.	Weight. Before treatment.	Weight. Final observation.	Treatment. Date given.	Treatment. Etharsanol.	Treatment. Naganol.	Duration between last injection and final observation. Yrs.	mons.	Final observation.
			kg.	*kg.*		*g.*	*g.*	*Yrs.*	*mons.*	
8	69	June 17, 1934	149	191	June 19, 1934	2.24	1.49	2	1.5	No relapse; compliment-fixation test negative; condition good.
					June 25, 1934	2.24	0.745			
					July 1, 1934	2.24	0.745			
9	71	Oct. 2, 1934	118	157	Oct. 3, 1934	1.77	1.18	1	10	Do.
					Oct. 9, 1934	1.77	0.59			
					Oct. 16, 1934	1.77	0.59			
10	72	Apr. 30, 1935	137	163	May 3, 1935	2.06	1.37	1	3	Do.
					May 9, 1935	2.06	0.685			
					May 16, 1935	2.06	0.685			

DISCUSSION

Treatment of equine surra with intrathecal-intravenous injections of naganol.—All of the seven horses employed failed to respond to the treatment given. While horses 67 and 70 died in the course of the treatment, horse 73 was killed in extremis at the end of the post-treatment observation period covering twenty-four days. Moreover, horse 67 being a worn-out, castaway calesa animal was quite susceptible to surra organisms and evidently too weak to bear the medicament administered, hence considered a poor risk. Horse 71 received two sets of injections; horses 68, 69, and 72, each received a complete course of treatment (in fact horse 68 received four sets of simultaneous intrathecal-intravenous injections), but relapses were noted in all cases. So far as the results of the experiments went, they disagree with the findings of Edwards and Williams in their studies of surra in India, but to some extent support those of Tubangui (1930) wherein tartar emetic was used. Furthermore, interesting evidence was shown by horse 68 in which the parasites in the cerebrospinal canal were absent as determined by animal inoculation, but not to the extent of complete absence, as a relapse was likewise observed at the end of the post-treatment observation period covering one hundred twenty-seven days. A similar condition was presented by horse 73, but although it showed nervous involvement the organisms were never recovered, probably due to the fact that the animal was killed in extremis quite early after treatment. Considering that naganol has been found effective against surra without nervous complication, the above circumstance would be difficult to explain were it not for the findings of Reichenow (1921) in his work on human trypanosomiasis wherein he stated that trypanosomes decreased or even totally disappeared in the cerebrospinal fluid after intrathecal injections, but the parasites always returned—a fact explained by the assumption that medicaments introduced into the cerebrospinal canal do not diffuse evenly with the liquor cerebralis and more especially do not penetrate into the ventricles of the brain, thus some of the trypanosomes may remain unaffected and subsequently bring about a relapse.

Treatment of relapsed horses with etharsanol-naganol combination.—The three animals (horses 69, 71, and 72 in experiments 8, 9, and 10) subjected to simultaneous treatment with etharsanol and naganol all responded satisfactorily. The results here presented furnish further evidence of the efficacy of

the etharsanol-naganol treatment against equine surra. The drawback, however, is the toxicity of the combination in some natural cases of surra treated where deaths have been recorded in the course of the treatment. In declaring the cases here described cured, microscopic examination of the blood, animal inoculation, complement-fixation test, and the period of post-treatment observation ranging from one to two years were observed. Furthermore, the increased weight and the good condition of the animals used at the termination of the investigation were also considered.

The complement-fixation test made in some of the horses used furnished an invaluable aid in declaring the animal free of surra. However, the test failed to detect the occurrence of the disease in the early stages even though the blood was already teeming with the surra parasites, as in horses 70, 71, and 72.

SUMMARY AND CONCLUSIONS

Experiments to determine the value of the simultaneous intrathecal and intravenous injections of naganol and the combination of etharsanol and naganol treatment in relapsed animals were performed.

Of the seven horses employed in the intrathecal-intravenous method, four were able to stand the complete course of the treatment with the exception of one which received only two injections, but all four relapsed. Of the remaining animals two died in the course of the treatment and one was killed in extremis at the end of the post-treatment observation period covering twenty-four days. In view of the above the intrathecal-intravenous injections of naganol as a treatment of experimental surra in Philippine horses was found to be of not much value and to some extent attended with danger.

The three animals subjected to the etharsanol-naganol treatment recovered. In declaring these cases recovered, animal inoculation, complement-fixation test, duration of post-treatment observation, microscopic examination of the blood, increase in weight, and good condition of the animals were considered.

LITERATURE CITED

BUBBERMAN, C., J. B. DOUWES, and V. E. C. VAN BERGEN. Over de toepassing van "Bayer 205" bij de surra van het paard in Nederlandsch-Indië. Veeartsenijkundige Mededeeling en Depart. v. Landbouw, Nijverheid en Handel, Buitenzorg No. 50 (1925) 64. Summarized: Trop. Vet. Bull. 13 (1925) 73–76.

EDWARDS, J. T. The chemotherapy of surra of horses and cattle in India. Journ. Comp. Path. & Therap. **39** (1926) 83–112; 169–201.

REICHENOW, EDWARD. Ueber Trypanosoma gambiense im Liquor cerebrospinalis des Menschen. Ber. Klin. Wochenschrift **58** (1921) 251–253.

RODENWALDT, E., and J. B. DOUWES. Over de toepassing van Bayer 205 bij de surra van het paard in Nederlandsch-Indië. Ned. Ind. Bladen v. Diergeneesk. en Dierenteelt. **33** (1922) 1–79. Summarized: Trop. Vet. Bull. **11** (1923) 45–50.

TUBANGUI, MARCOS A. Studies on the treatment of equine surra in the Philippines, I. Philip. Agriculturist **18** (1930) 609–620.

WILLIAMS, A. J. The treatment of surra (trypanosomiasis) of equines in India by intravenous-intrathecal injections of Bayer 205. Journ. Roy. Army Vet. Corps **1** (1929) 37–42.

YUTUC, LOPE M. Experimental studies on the curative treatment of surra in native horses in the Philippines, I. Philip. Journ. Sci. **54** (1934) 9–27.

TANNIN CONTENT OF PHILIPPINE OAK BARKS

By F. M. YENKO and LUZ BAENS

Of the Bureau of Science, Manila

This paper is a continuation of our work on the tannin content of Philippine barks and woods.[1]

In the Philippines the tanning of sole leather is now done mostly with kamachile bark, *Pithecolobium dulce* (Roxb.) Benth. and there is often obtained a poor quality of leather with a disagreeable odor.

Hides tanned properly with oak-bark extract give a leather that is distinguished by a light tan color, firm texture, and durability. The oak tannin combines well with hides and penetrates quickly; consequently it is one of the best materials for producing heavy leather.[2]

According to Wilson,[3] oak barks collected from different countries had a tannin content that varied from 1.5 to 29 per cent.

Formerly the species of oak commonly used for tanning were *Quercus robur* and *Q. prinus,* containing 9 to 12 per cent tannin; *Quercus densiflora,* with a tannin content of 10 to 29 per cent, was also employed when available.

Recently we analyzed several species of oak bark grown in various districts in the Philippines. The official hide-powder method, adopted by the American Leather Chemists Association, was used. The results are recorded in Table 1. As shown by the data six species of Philippine oak bark contained more than 10 per cent tannin. Pieces of hides were tanned very satisfactorily with infusions of these barks. Apparently these barks compare favorably with those in other countries.

Of the Philippine barks analyzed *Quercus pruinosa,* grown at the Cebu Forest Station, gave the highest tannin content (17.76 per cent). When this species was grown near Baguio it gave the lowest tannin content (3.52 per cent).

[1] Baens, L., F. M. Yenko, and A. P. West, Philip. Journ. Sci. **55** (1934) 177.

[2] Rogers, A., Practical Tanning (1922) 265. Bennett, H. G., Animal Proteins (1921) 34.

[3] The Chemistry of Leather Manufacture 1 (1928) 401 and 407.

TABLE 1.—*Analyses of Philippine oak barks.*

Sample No.[a]	Scientific name.	Tannin.	Nontannin.	Purity.	Solids.		
					Total.	Soluble.	Insoluble.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
1	*Quercus Robinsonii* Merr.	13.96	3.95	77.95	19.58	17.91	1.67
2	do	15.65	5.14	75.28	23.97	20.79	3.18
3	*Quercus Mabesae* Merr.	11.47	4.09	73.71	16.32	15.56	0.76
4	*Quercus soleriana* Vid.	12.81	3.51	78.49	18.17	16.32	1.85
5	*Quercus philippinensis* A. DC.	14.90	3.08	82.87	19.61	17.98	1.63
6	*Quercus Bennettii* Miq.	16.01	3.30	82.91	21.69	19.31	2.38
7	*Quercus philippinensis* A. DC.	15.79	3.39	82.33	23.38	19.18	4.20
8	*Quercus ovalis* Blco.	3.77	3.01	55.60	7.10	6.78	0.32
9	*Quercus pruinosa* Bl.	3.52	4.19	45.65	8.05	7.71	0.34
10	*Quercus Woodii* Hance	9.06	11.20	44.72	22.56	20.26	2.30
11	*Quercus Curranii* Merr.	8.78	10.40	45.78	20.15	19.18	0.97
12	*Quercus soleriana* Vid.	4.78	6.18	43.61	11.67	10.96	0.71
13	*Quercus sundaica* Bl.	8.78	11.78	42.70	20.80	20.56	0.24
14	*Quercus apoensis* Elmer	6.08	4.71	56.35	11.68	10.79	0.89
15	*Quercus pruinosa* Bl.	17.76	8.85	66.74	27.79	26.61	1.18

[a] Samples 1 to 7 were collected at Los Baños, Laguna Province. Samples 8 to 13 were collected at Baguio, Mountain Province. Sample 14 was collected at Babatñgon, Leyte. Sample 15 was collected at the forest station in Cebu.

Oak barks from trees grown at the Los Baños Forest Station gave a tannin content that varied from 11.47 to 16.01 per cent.

In this investigation the oak barks used were kindly presented to us by Mr. Arthur F. Fischer, director of the Bureau of Forestry.

The identification of barks 1 to 7 was made by Mr. Mamerto D. Sulit, of the Bureau of Forestry. All the other barks were identified by Dr. Eduardo Quisumbing, of the Bureau of Science.

SUMMARY

Philippine oak barks of various species were analyzed for their tannin content.

Six species contained more than 10 per cent tannin. The Philippine barks compare favorably in tannin content with oak barks grown in other countries.

The species *Quercus pruinosa,* grown at the Cebu Forest Station, gave the highest tannin content (17.76 per cent). When this species was grown near Baguio it gave the lowest tannin content (3.52 per cent).

EFFECT OF MOLDS ON SOME PHILIPPINE TANNING LIQUORS, II

By LUZ BAENS and F. M. YENKO
Of the Bureau of Science, Manila

FOUR TEXT FIGURES

This paper is a continuation of the work reported in our first publication[1]—the effect of molds on Philippine tanning liquors.

Several years ago we investigated the tannin content of a large number of Philippine tanbarks.[2] Some of them were found to contain a rather high percentage of tannin as shown by the data recorded in Table 1, in which there is also included the analysis of betel-nut kernel.

These particular materials (Table 1) were selected for the mold experiments recorded in this paper. Brief descriptions of the trees from which they were obtained are as follows:

Betel nut, *Areca catechu* L.[3] This tall and slender palm is found in and about towns throughout the settled areas of the Philippines. It reaches a height of 10 meters and a diameter of 10 to 15 centimeters. It has dark green pinnate leaves about 3 meters long. The reddish yellow fruits grow on the stem below the leaves. This palm is frequently spontaneous and occurs in second-growth forests, but is rarely found distant from cultivation. It has been reported from a virgin forest in only a single locality in Palawan.

In the Philippines, as in all the Indo-Malayan and Polynesian regions, the fruits of this palm are extensively utilized for chewing with lime and the leaves of the betel pepper. They are also used to some extent in dyeing red and black shades.

Black wattle, *Acacia decurrens* Willd. The bark was obtained from trees grown in Bukidnon Province, Mindanao. In the

[1] Yenko, F. M., Luz Baens, and F. B. Serrano, Philip. Journ. Sci. 60 (1936) 241.

[2] Baens, Luz, F. M. Yenko, A. P. West, and H. M. Curran, Philip. Journ. Sci. 55 (1934) 177.

[3] Brown, William H.. Minor Products of Philippine Forests 1 (1920) 144.

sitio called Kaatoan these trees reached an average height of 5.29 meters in about four years. They were cultivated from seeds that were obtained from the Forest Research Institute, Buitenzorg, Java. In some districts in Bukidnon the black-wattle tree grows very well, and it is quite likely that it could be cultivated successfully on rich soil where the climate is similar to that of Bukidnon.

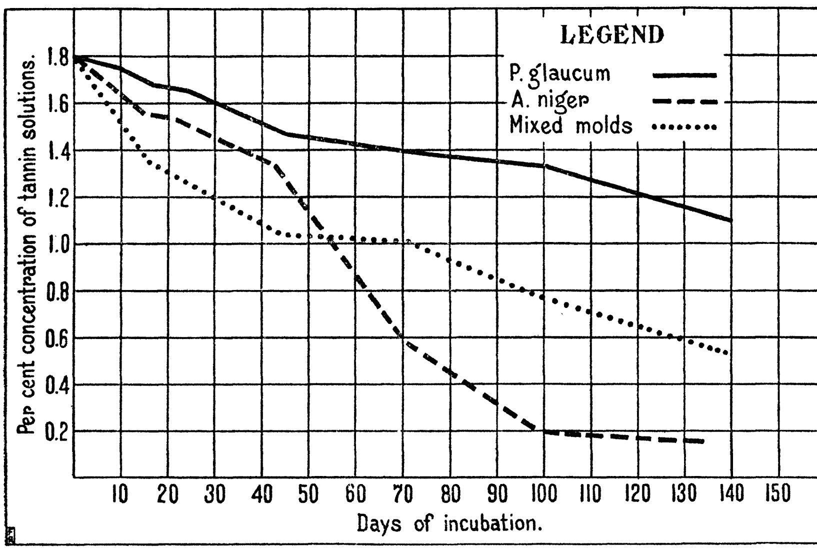


FIG. 1. Effect of molds on betel-nut solutions.

Kalumpit, *Terminalia edulis* Blco.[4] A height of about 35 meters and a diameter of about 1 meter may be attained by this tree. The fruits are about 3 centimeters wide, smooth, dark red, fleshy, and acid, and should make a good preserve.

This species is very common and widely distributed in the forests from northern Luzon to southern Mindanao, and it has been cultivated at the Lamao Experiment Station.

Kamachile, *Pithecolobium dulce* (Roxb.) Benth.[5] The tree reaches a height of 5 to 8 meters. This species is a native of tropical America but is now thoroughly naturalized in the Philippines where it is common and widely distributed. Large quantities of the bark are gathered for tanning purposes.

EXPERIMENTAL PROCEDURE

Solutions (2 per cent tannin content) were prepared from tanning extracts obtained from betel-nut kernel, and from black

[4] Brown, William H., Minor Products of Philippine Forests 2 (1920) 354.
[5] Tom. cit. 292.

wattle, kalumpit, and kamachile barks. They were heated on a steam bath for thirty minutes to pasteurize. Two-liter portions of each were separately inoculated with spores of the molds *Aspergillus niger* and *Penicillium glaucum.* Other 2-liter portions were exposed to the air and allowed to be infected with a mixture of molds existing under ordinary laboratory conditions.

The tannin content of the solutions was determined before inoculation, and periodic analyses were made afterwards.

In selecting aliquot portions of the solutions for analysis the flasks were rotated gently between the hands in order to get average samples, and care was taken to avoid disturbing the

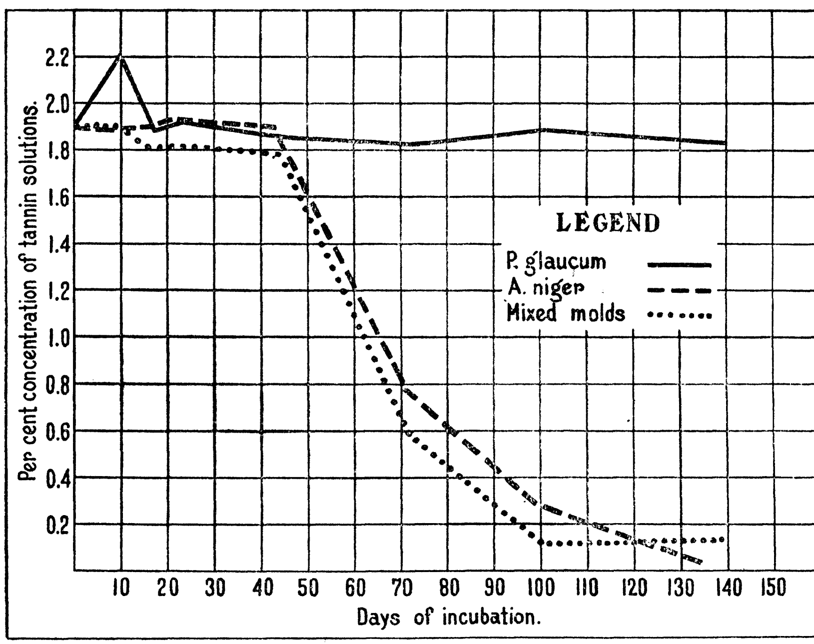


FIG. 2. Effect of molds on black-wattle solutions.

mold growth on the surface. Evaporation losses were made up with distilled water before samples were taken for analysis. The results are recorded in Tables 2 to 13.

In general the tannin content of the various extracts decreased, more or less, due to mold action. Usually the greatest decrease occurred after about forty days' exposure.

In comparing the pH values with the tannin content of the various extracts, we note certain relations.

A rise in the pH value was accompanied by a large decrease in tannin content. Acids inhibit the action of molds and the

destruction of tannins; consequently, in general, the less acid present the greater will be the decrease in tannin content. For instance, betel-nut extract inoculated with *A. niger* showed a rise in pH and a relatively high loss in tannin (Table 2). Mixed molds (Table 4) gave somewhat the same results.

When the betel-nut extract was inoculated with *P. glaucum* there was first a rise and later a decrease in pH, indicating increased acidity. There was also some loss in tannin (Table 3). The increase in acidity evidently inhibited the mold action but was not sufficient to stop it.

Treated with *A. niger* the betel-nut solution lost more tannin than treated with *P. glaucum* (Tables 2 and 3). The betel-nut extract was more resistant to *P. glaucum* than to *A. niger.*

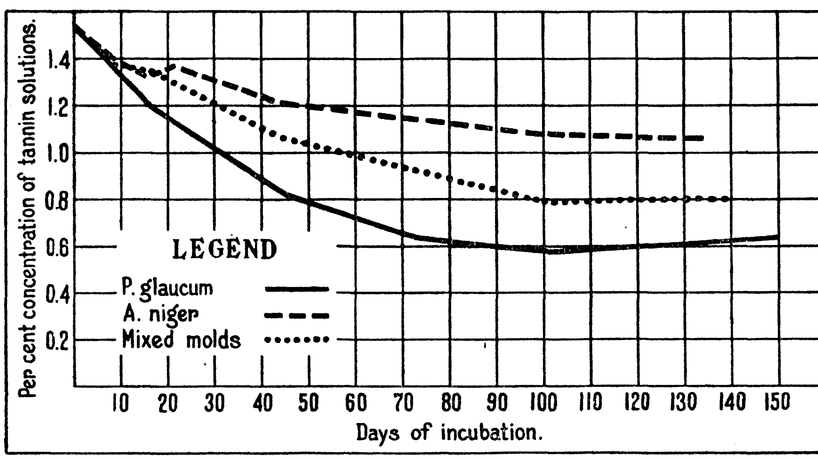


FIG. 3. Effect of molds on kalumpit solutions.

Inoculation of black-wattle extract with the mold *A. niger* gave a decrease in the pH value that was accompanied by a marked loss in tannin content (Table 5). In fact, after about four months of mold action hardly any tannin remained in the solution. In this case the increase in acidity failed to stop the mold action because the black-wattle tannin is evidently very susceptible to the action of the mold *A. niger.*

When the black-wattle tannin solution was inoculated with *P. glaucum* there was a comparatively large decrease in the pH (5.1 to 4.1). However, there was only a slight loss in tannin (Table 6). It would appear that black-wattle tannin is quite resistant to the mold *P. glaucum.*

The tannin content of the black-wattle extract decreased a great deal when the extract was exposed to the mixed molds in

the air, but there was not much change in the pH value (Table 7). Since *A. niger* is more abundant in the air than *P. glaucum* these results were to be expected in view of the data recorded in Tables 5 and 6.

In all the experiments with the kalumpit bark (Tables 8, 9, and 10) there was a large reduction in the pH. Here again, the increased acidity apparently inhibited the action of the molds. Kalumpit bark was more resistant to the action of *A. niger* than to that of *P. glaucum*. The mixed molds gave values that were about the average of the individual molds.

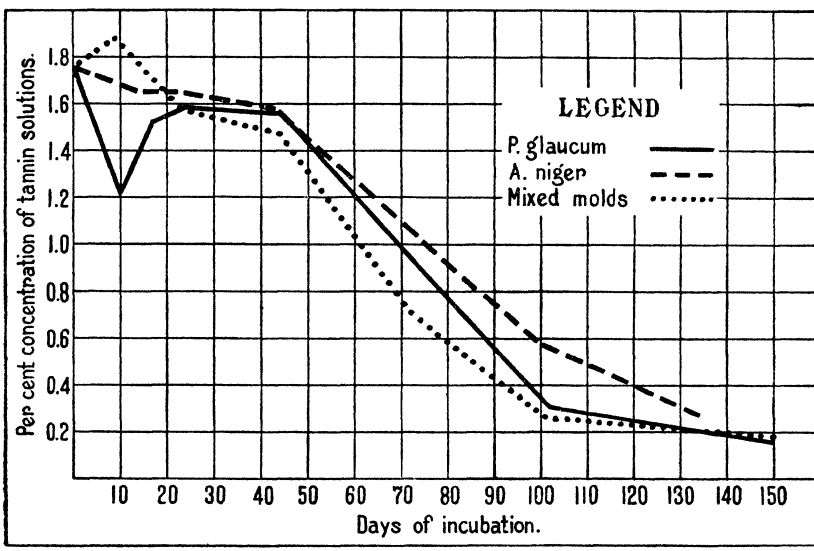


FIG. 4. Effect of molds on kamachile solutions.

The different molds gave the kamachile extract a slight increase in pH that was accompanied by an unusually large loss in tannin. This extract is very susceptible to mold action (Tables 11, 12, and 13).

The results recorded in the tables are illustrated graphically in the various charts (text figs. 1, 2, 3, and 4).

The barks used in this investigation were kindly presented to us by Mr. Arthur F. Fischer, director of the Bureau of Forestry.

SUMMARY

In this investigation a study was made of the effect of molds on some Philippine tanning liquors.

The molds used were *Aspergillus niger, Penicillium glaucum,* and mixtures consisting largely of these two.

The tannin liquors employed were extracts of betel-nut kernel and barks of black wattle, kalumpit, and kamachile.

In general the tannin content of the various extracts decreased, more or less, due to mold action.

A rise in the pH value of the extracts was accompanied by a large decrease in tannin content. Acids inhibit the action of molds and consequently the less the acid the greater the mold action.

Experiment showed that extracts of betel-nut and black wattle were very susceptible to the action of *A. niger* but were rather resistant to *P. glaucum.*

Kalumpit bark was more resistant to the action of *A. niger* than to that of *P. glaucum.*

Both molds had a deleterious effect on kamachile extract.

TABLE 1.—*Analysis of Philippine barks and betel-nut kernels.*

Sample.	Tannin.	Nontannin.	Purity.	Solids.		
				Total.	Soluble.	Insoluble.
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
Betel-nut kernel; *Areca catechu* [a]	20.16	9.51	67.95	32.19	29.67	2.52
Black wattle; *Acacia decurrens* [b]	45.05	10.73	80.76	56.58	55.78	0.80
Kalumpit; *Terminalia edulis* Blanco [b]	34.11	7.23	82.51	43.17	41.34	1.83
Kamachile; *Pithecolobium dulce* (Roxb.) Benth. [b]	26.12	9.53	73.27	37.41	35.65	1.76

[a] Analysis made in the tanning laboratory, Bureau of Science.
[b] Analysis made by the Philippine Cutch Corporation, Zamboanga, P. I.

TABLE 2.—*Betel-nut tannin solution inoculated with Aspergillus niger.*

Date of analysis.	pH.	Tannin.	Nontannin.	Purity.	Solids.		
					Total.	Soluble.	Insoluble.
1935		*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
July 2 [a]	4.9	1.81	1.04	63.51	3.07	2.85	0.22
July 10	5.1	1.67	0.73	69.59	2.58	2.40	0.18
July 17	5.4	1.56	0.58	72.90	2.35	2.14	0.21
July 24	5.4	1.53	0.53	74.27	2.30	2.06	0.24
August 14	5.2	1.34	0.21	86.45	1.85	1.55	0.30
September 11	5.2	0.58	0.75	43.61	1.75	1.33	0.42
October 9	5.0	0.20	1.02	16.39	1.63	1.22	0.41
November 13	5.6	0.17	0.89	16.04	1.57	1.06	0.51

[a] Analysis made before inoculation. All other analyses recorded in this table were made after inoculation.

TABLE 3.—*Betel-nut tannin solution inoculated with Penicillium glaucum.*

Date of analysis.	pH.	Tannin.	Nontannin.	Purity.	Solids.		
					Total.	Soluble.	Insoluble.
1935		*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
July 2 [a]	4.9	1.81	1.04	63.51	3.07	2.85	0.22
July 12	5.1	1.75	0.74	70.28	2.74	2.49	0.25
July 19	5.1	1.68	0.62	73.04	2.54	2.30	0.24
July 26	5.5	1.66	0.57	74.44	2.45	2.23	0.22
August 16	5.0	1.47	0.51	74.24	2.23	1.98	0.25
September 13	4.6	1.39	0.47	74.73	2.11	1.86	0.25
October 11	4.5	1.33	0.50	72.68	2.09	1.83	0.26
November 19	4.3	1.11	0.63	63.79	2.03	1.74	0.29

[a] Analysis made before inoculation. All other analyses recorded in this table were made after inoculation.

TABLE 4.—*Betel-nut tannin solution inoculated with mixed molds.*

Date of analysis.	pH.	Tannin.	Nontannin.	Purity.	Solids.		
					Total.	Soluble.	Insoluble.
1935		*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
July 2 [a]	4.9	1.81	1.04	63.51	3.07	2.85	0.22
July 11	4.9	1.54	0.68	69.37	2.52	2.22	0.30
July 18	5.5	1.35	0.54	71.43	2.25	1.89	0.36
July 25	5.7	1.28	0.46	73.56	2.05	1.74	0.31
August 15	5.5	1.04	0.44	70.27	1.89	1.48	0.41
September 12	5.1	1.00	0.39	71.94	1.82	1.39	0.43
October 10	4.9	0.77	0.60	56.20	1.85	1.37	0.48
November 18	5.9	0.54	0.73	42.52	1.70	1.27	0.43

[a] Analysis made before inoculation. All other analyses recorded in this table were made after inoculation.

TABLE 5.—*Black-wattle tannin solution inoculated with Aspergillus niger.*

Date of analysis.	pH.	Tannin.	Nontannin.	Purity.	Solids.		
					Total.	Soluble.	Insoluble.
1935		*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
July 2 [a]	5.1	1.90	0.87	68.59	2.94	2.77	0.17
July 10	5.1	1.89	0.64	74.70	2.76	2.53	0.23
July 17	5.1	1.90	0.45	80.85	2.58	2.35	0.23
July 24	5.4	1.93	0.37	83.91	2.52	2.30	0.22
August 14	5.5	1.89	0.26	87.91	2.33	2.15	0.18
September 11	4.8	0.78	0.50	60.94	1.80	1.28	0.52
October 9	4.7	0.29	0.32	47.54	1.62	0.61	1.01
November 13	4.7	0.04	0.38	9.52	1.65	0.42	1.23

[a] Analysis made before inoculation. All other analyses recorded in this table were made after inoculation.

TABLE 6.—*Black-wattle tannin solution inoculated with Penicillium glaucum.*

Date of analysis.	pH.	Tannin.	Nontannin.	Purity.	Solids.		
					Total.	Soluble.	Insoluble.
1935		*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
July 2 [a]	5.1	1.90	0.87	68.59	2.94	2.77	0.17
July 12	4.4	2.25	0.27	89.29	2.68	2.52	0.16
July 19	4.0	1.88	0.59	76.11	2.61	2.47	0.14
July 26	4.4	1.92	0.59	76.50	2.60	2.51	0.09
August 16	4.8	1.86	0.35	84.16	2.31	2.21	0.10
September 13	4.3	1.83	0.27	87.14	2.22	2.10	0.12
October 11	4.1	1.89	0.22	89.57	2.19	2.11	0.08
November 19	4.1	1.83	0.21	89.71	2.24	2.04	0.20

[a] Analysis made before inoculation. All other analyses recorded in this table were made after inoculation.

TABLE 7.—*Black-wattle tannin solution inoculated with mixed molds.*

Date of analysis.	pH.	Tannin.	Nontannin.	Purity.	Solids.		
					Total.	Soluble.	Insoluble.
1935		*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
July 2 [a]	5.1	1.90	0.87	68.59	2.94	2.77	0.17
July 11	5.1	1.90	0.49	79.50	2.55	2.39	0.16
July 18	5.5	1.81	0.33	84.58	2.39	2.14	0.25
July 25	5.7	1.81	0.29	86.19	2.34	2.10	0.24
August 15	5.8	1.78	0.24	88.12	2.20	2.02	0.18
September 12	4.7	0.57	0.66	46.34	1.95	1.23	0.72
October 10	4.6	0.12	0.76	13.64	1.87	0.88	0.99
November 18	4.8	0.13	0.60	17.81	1.87	0.73	1.14

[a] Analysis made before inoculation. All other analyses recorded in this table were made after inoculation.

TABLE 8.—*Kalumpit tannin solution inoculated with Aspergillus niger.*

Date of analysis.	pH.	Tannin.	Nontannin.	Purity.	Solids.		
					Total.	Soluble.	Insoluble.
1935		*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
July 2 [a]	4.4	1.54	0.51	75.12	2.28	2.05	0.23
July 10	4.0	1.40	0.47	74.87	2.16	1.87	0.29
July 17	3.9	1.32	0.41	76.30	2.04	1.73	0.31
July 24	3.7	1.35	0.40	77.14	2.02	1.75	0.27
August 14	3.7	1.22	0.37	76.73	1.90	1.59	0.31
September 11	3.5	1.15	0.37	75.66	1.84	1.52	0.32
October 9	3.2	1.09	0.37	74.66	1.72	1.46	0.26
November 13	3.3	1.06	0.33	76.26	1.43	1.39	0.04

[a] Analysis made before inoculation. All other analyses recorded in this table were made after inoculation.

TABLE 9.—*Kalumpit tannin solution inoculated with Penicillium glaucum.*

Date of analysis.	pH.	Tannin.	Nontannin.	Purity.	Solids.		
					Total.	Soluble.	Insoluble.
1935		*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
July 2 [a]	4.4	1.54	0.51	75.12	2.28	2.05	0.23
July 12	3.8	1.34	0.41	76.57	2.00	1.75	0.25
July 19	3.6	1.20	0.36	76.92	1.88	1.56	0.32
July 26	3.4	1.11	0.32	77.62	1.84	1.43	0.41
August 16	3.3	0.83	0.34	70.94	1.56	1.17	0.39
September 13	3.2	0.64	0.39	62.14	1.45	1.03	0.42
October 11	3.1	0.58	0.45	56.31	1.35	1.03	0.32
November 29	3.3	0.64	0.50	56.14	1.38	1.14	0.24

[a] Analysis made before inoculation. All other analyses recorded in this table were made after inoculation.

TABLE 10.—*Kalumpit tannin solution inoculated with mixed molds.*

Date of analysis.	pH.	Tannin.	Nontannin.	Purity.	Solids.		
					Total.	Soluble.	Insoluble.
1935		*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
July 2 [a]	4.4	1.54	0.51	75.12	2.28	2.05	0.23
July 11	4.4	1.37	0.43	76.11	2.05	1.80	0.25
July 18	4.3	1.35	0.43	75.84	2.05	1.78	0.27
July 25	3.9	1.29	0.34	79.14	1.90	1.63	0.27
August 15	3.4	1.07	0.28	79.26	1.65	1.35	0.30
September 12	3.3	0.93	0.28	76.86	1.67	1.21	0.46
October 10	3.2	0.79	0.28	73.83	1.55	1.07	0.48
November 18	3.1	0.80	0.30	72.73	1.50	1.10	0.40

[a] Analysis made before inoculation. All other analyses recorded in this table were made after inoculation.

TABLE 11.—*Kamachile tannin solution inoculated with Aspergillus niger.*

Date of analysis.	pH.	Tannin.	Nontannin.	Purity.	Solids.		
					Total.	Soluble.	Insoluble.
1935		*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
July 2 [a]	5.7	1.76	0.88	66.67	3.04	2.64	0.40
July 10	5.9	1.70	0.83	67.19	2.91	2.53	0.38
July 17	6.3	1.65	0.79	67.62	2.86	2.44	0.42
July 24	6.3	1.65	0.80	67.35	2.83	2.45	0.38
August 14	6.2	1.59	0.79	66.81	2.79	2.38	0.41
September 11	5.9	1.08	1.29	45.57	2.60	2.37	0.23
October 9	5.6	0.59	1.80	24.69	2.54	2.39	0.15
November 13	5.9	0.28	2.15	11.52	2.51	2.43	0.08

[a] Analysis made before inoculation. All other analyses recorded in this table were made after inoculation.

TABLE 12.—*Kamachile tannin solution inoculated with Penicillium glaucum.*

Date of analysis.	pH.	Tannin.	Nontannin.	Purity.	Solids.		
					Total.	Soluble.	Insoluble.
1935		*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
July 2 [a]	5.7	1.76	0.88	66.67	3.04	2.64	0.40
July 12	5.7	1.23	1.23	50.00	2.84	2.46	0.38
July 19	5.8	1.53	0.78	66.23	2.75	2.31	0.44
July 26	5.7	1.59	0.77	67.37	2.72	2.36	0.36
August 16	6.1	1.56	0.78	66.66	2.62	2.34	0.28
September 13	6.1	0.93	1.46	38.91	2.60	2.39	0.21
October 11	5.8	0.31	2.08	12.97	2.56	2.39	0.17
November 29	5.7	0.17	2.35	6.75	2.62	2.52	0.10

[a] Analysis made before inoculation. All other analyses recorded in this table were made after inoculation.

TABLE 13.—*Kamachile tannin solution inoculated with mixed molds.*

Date of analysis.	pH.	Tannin.	Nontannin.	Purity.	Solids.		
					Total.	Soluble.	Insoluble.
1935		*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
July 2 [a]	5.7	1.76	0.88	66.67	3.04	2.64	0.40
July 11	5.9	1.89	0.51	78.75	2.70	2.40	0.30
July 18	6.4	1.73	0.77	69.20	2.64	2.50	0.14
July 25	6.1	1.58	0.70	69.30	2.51	2.28	0.23
August 15	5.8	1.47	0.75	66.22	2.48	2.22	0.26
September 12	5.8	0.71	1.56	31.28	2.44	2.27	0.17
October 10	5.5	0.27	2.07	11.54	2.48	2.34	0.14
November 29	5.8	0.18	2.25	7.41	2.64	2.43	0.21

[a] Analysis made before inoculation. All other analyses recorded in this table were made after inoculation.

ILLUSTRATIONS

TEXT FIGURES

PHILIPPINE ANNATTO DYE AS A COLORING AGENT

By SIMEONA SANTIAGO TANCHICO and AUGUSTUS P. WEST
Of the Bureau of Science, Manila

THREE PLATES

The bulk of the dyes that are now used commercially are synthetic products.[1] There are, however, a few natural dyes [2] that are still employed. One of the most important of these is annatto, which is obtained from the seeds of the annatto tree. This tree is known botanically as *Bixa orellana* Linn. It is a native of tropical America and has been introduced into many other countries. For more than a hundred years the tree has been cultivated in India, where the dye has been used for various purposes.[3] Years ago annatto was introduced into the Philippines, where it is grown in and about towns, and is called, in Tagalog, *achuete*.

The annatto tree reaches a height of 4 to 6 meters. The flowers are white to pinkish in color. The seeds are inclosed in capsules that are somewhat rounded and covered with soft bristles. The seeds are about the size of grapeseeds and are pyramidal in shape. They are covered with a soft resinous pulp that has an attractive vermilion color. This pulp surrounding the seeds contains the annatto dye.

Formerly annatto was employed to some extent for dyeing certain textiles. It is not a fast dye, and consequently, like most other natural dyes, it has been replaced by synthetic colors. However, it is still used for coloring butter and cheese.

In certain districts along the Amazon River the Indian families make ornamental pottery and drinking cups which they sell to traders and travelers. These products are often painted rather cleverly with different colors. The red tints are made with annatto dye.[4]

[1] Cain and Thorpe, Synthetic Dyestuffs. Revised by J. F. Thorpe and R. P. Linstead (1933).

[2] Perkin, A. G., and A. E. Everest, Natural Organic Coloring Matters (1918).

[3] Watt, G., Dictionary of the Economic Products of India 1 (1891) 454.

[4] Bates, H. W., The Naturalist On the River Amazons (1931) 122.

In the Philippines one can usually find annatto seeds for sale in the larger markets. The seeds are used mostly for coloring local foods.

Annatto is exported from Jamaica, Ecuador, Brazil, and neighboring regions, and also from India and Java, but not from the Philippines.

According to Thorpe: [5]

> Annatto comes into the market in the form of cakes, and among the different varieties Cayenne annatto is the most esteemed, and is considered to be the richest in colouring matter. It should contain from 10 to 12 p.c. of the pure dye, and not more than 5 p.c. of ash, whereas the amount of colouring matter in the Bengal product is frequently lower than 6 p.c.

Annatto dye contains two coloring matters. It consists mostly of bixin (cinnabar red) together with some orellin (yellow). Etti,[6] who first prepared crystallized bixin, proposed the formula $C_{28}H_{34}O_5$ for it. There has been some controversy in chemical literature as to the correctness of this formula, and some investigators have suggested somewhat different formulas.[7]

Occasionally the Bureau of Science receives letters requesting recipes in which annatto dye is one of the constituents. For this extension service we have worked out some recipes that serve to illustrate how this dye may be used.

EXPERIMENTAL PROCEDURE

Various methods have been suggested for extracting the dyestuff contained in the pulp surrounding the annatto seeds. One of the simplest methods is to place the seeds in a mortar, add some water and stir the seeds around with a pestle. The colored solution is poured off and the trituration process repeated until no more color is extracted. The combined water solutions are acidified with 4 per cent acetic acid, or vinegar. This precipitates the crude dye which is obtained by pouring off the supernatant liquid or by filtering.

Bixin is the more useful coloring matter in the crude dye and is obtained conveniently by Zwick's method.[8] The seeds are extracted for twenty-four hours with boiling chloroform. The extract is then poured off from the seeds and the excess solvent

[5] Thorpe, E., Dictionary of Applied Chemistry 1 (1927) 332.
[6] Ber. Deut. Chem. Gesell. 7 (1874) 446; 11 (1878) 864.
[7] Thorpe, E., Dictionary of Applied Chemistry 1 (1927) 333.
[8] Thorpe, E., op. cit. 332.

removed by distilling. The concentrated solution is evaporated to dryness and the residue is treated several times with petroleum ether to remove oily constituents. The red powder that remains is crystallized from chloroform giving crystals that melt at 165° C.

The red powder, or crystals, dissolved in concentrated sulphuric acid, gives a solution with a bright blue color, and on dilution with water a green precipitate is obtained (test for bixin).

Kolhaas and Koppel [9] have recently suggested another method for producing annatto paste in which the dye is extracted with dilute alkali.

COMMERCIAL PRODUCTS

Although the recipes that follow have given satisfactory results they are presented as suggestions rather than specific directions. The exact quantity of the individual ingredients in each recipe can usually be varied to some extent. Again the more costly constituents might be replaced by substitutes that are cheaper if quality is not a matter of primary importance.

FLOORWAX AND FURNITURE POLISH

Materials:

Beeswax, g	80
Carnauba wax, g	80
Paraffin, g	80
Tallow, g	80
Hercules rosin, g	80
Turpentine (colored with annatto), cc	500

The colored turpentine is prepared by treating 250 grams of annatto seeds with 1,000 cubic centimeters of turpentine. Allow the mixture to stand overnight, then pour off the supernatant liquid from the seeds. This is the stock solution of annatto-colored turpentine that is used for coloring.

The solid materials (waxes, paraffin, tallow, and rosin) are melted together in a casserole over a small flame. The flame is then extinguished and the annatto-colored turpentine added. The mixture is stirred thoroughly and while still hot is poured into containers and cooled quickly. The stoppers of the containers should fit tightly to prevent loss of solvent.

The polish should be applied with a soft cloth and the polished surface rubbed briskly to produce a brilliant luster.

[9] Indische Mercuur **58** (1935) 525.

SHOE POLISH (FOR BROWN OR TAN SHOES)

Materials:

Carnauba wax, g	50
Beeswax, g	100
Paraffin, g	80
Tallow, g	20
Annatto-colored turpentine, cc	300
Nitrobenzene, cc	10

The annatto-colored turpentine is prepared as in the recipe for furniture polish.

The solid materials are melted together in a casserole over a small flame. When the materials are completely melted the flame is extinguished and the annatto-colored turpentine added. The mixture is now stirred thoroughly, and when it is somewhat cool the nitrobenzene is added and the product poured into containers.

The polish should be applied with a soft cloth and the polished surface rubbed briskly to produce a brilliant luster.

NAIL GLOSS

Materials:

Celluloid, g	50
Amyl acetate, cc	450
Acetone, cc	450
Acetone saturated with annatto, cc	1

The celluloid is first dissolved in amyl acetate. Acetone is now poured into this solution, after which there is added about 1 cubic centimeter of a solution of acetone saturated with annatto.

This gloss should be applied with a small camel's hair brush. Finger nails treated with this gloss acquire a deep red color.

Scrap photo films can be used in place of celluloid but they should first be cleaned by treating with dilute alkali solution and washed well with water.

A saturated solution of annatto dye dissolved in acetone may be prepared by treating about 0.5 gram of annatto dye with 20 cubic centimeters of acetone.

The gloss may be removed by washing with acetone.

BRASS LACQUER

Materials:

Celluloid, g	50
Amyl acetate, cc	400
Acetone, cc	400
Acetone saturated with annatto, cc	1

The brass lacquer is made in the same manner as the nail gloss. Various shades may be obtained by varying the amount

of colored solution or the color may be omitted entirely. It may be applied with a soft brush or used as a spray.

If the liquid becomes too thick due to evaporation of the solvents (amyl acetate or acetone) it may be diluted with either of them.

When vases and other brass articles are allowed to stand around as ornaments they soon lose their brightness and luster and are no longer very attractive. If new or polished brassware is first treated with this preparation it retains its original brilliant appearance for a considerable length of time.

HAIR OIL

Macerate the annatto seeds in colorless and odorless coconut oil. Use sufficient seeds to obtain the desired color. When all the dye is dissolved remove the seeds by filtering and add a small quantity of any desired perfume.

WOOD STAIN

Annatto dye dissolved in acetone, chloroform, or ethyl acetate gives a dark red solution that can be used for staining wood. This colored solution may also be incorporated with an alcoholic solution of shellac if a colored shellac varnish is desired.

SUMMARY

The annatto tree, *Bixa orellana* Linn., is a native of tropical America and has been introduced into many other countries including the Philippines.

The seeds of the annatto tree are covered with a soft resinous pulp that contains a red dye known as annatto. Various methods have been suggested for extracting this dye.

Annatto is one of the very few natural dyes that is still used commercially. It is employed mostly for coloring butter and cheese. Local foods are often colored with it in the Philippines.

In order to illustrate how annatto dye may be used recipes for making the following products were worked out: Floorwax, furniture and shoe polish, nail gloss, brass lacquer, hair oil, and wood stain.

ILLUSTRATIONS

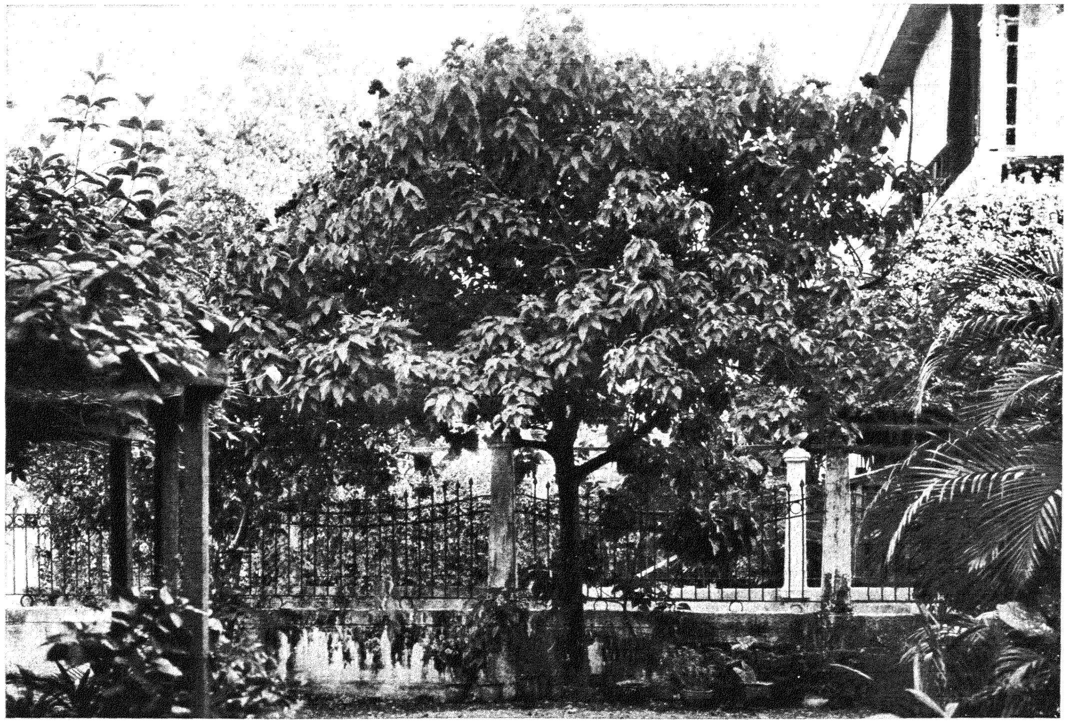
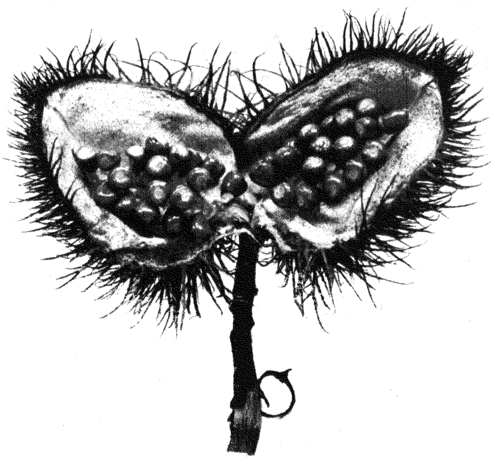
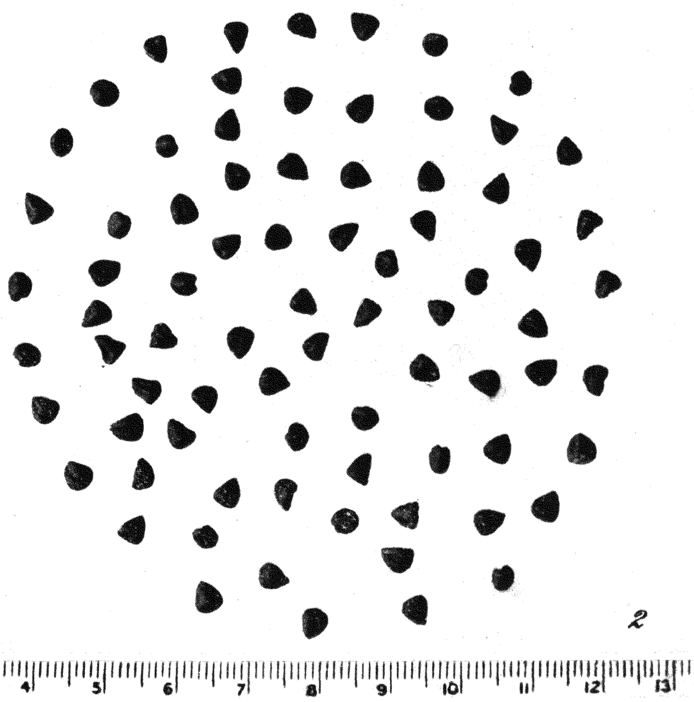


PLATE 1.

PLATE 2.



1



2

PLATE 3.

COMPOSITION OF PHILIPPINE PHYSIC-NUT OIL

By Aurelio O. Cruz and Augustus P. West
Of the Bureau of Science, Manila

THREE PLATES

Recently the Bureau of Science received several requests for information concerning the constituents of physic-nut oil. Experiments on this oil have been carried out in various laboratories, but the results were not concordant. To determine the exact composition of physic-nut oil the present investigation was therefore undertaken.

Physic-nut oil is obtained from the seeds of a small tree that grows to a height of 2 to 5 meters. This tree is a native of tropical America and is known botanically as *Jatropha curcas* Linn. For many years it has been grown in other countries, including the Philippines, where it is usually cultivated in and about towns to serve as a hedge plant. It is called in Tagalog *tubang-bakod*. *Tuba* is a name given to many plants of this family that are used for poisoning fish, and *bakod*, is the Tagalog word for "hedge" or "fence." Hence the name túbang-bakod. The seeds of this plant are inclosed in capsules that are mostly rounded.

The constants and characteristics of physic-nut oil have been determined by various investigators. The oil has strong purgative properties when taken internally, and it also contains a toxic substance.[1] It has been used medicinally in India[2] as a remedy for itch. In Portugal[3] it has been employed for soap making and as an illuminant. In the Philippines the oil is not extracted from the seeds.

[1] Anon., Bull. Imp. Inst. 17 (1919) 433. Heim, F., and J. Rullier, Bull. del'office colonial 12 (1919) 96.

[2] Watt, G., Dictionary of the Economic Products of India 4 (1890) 546.

[3] Lewkowitsch, J., Chemical Technology and Analysis of Oils, Fats, and Waxes 2 (1922) 2141.

Samples of physic-nut oil obtained from different countries gave iodine values [4] that varied from about 94 to 106. This oil would therefore be classified as a semidrying oil.

When the glycerides of physic-nut oil are converted into acids, these mixed acids, according to Lewkowitsch,[5] have about equal amounts of the unsaturated oleic and linolic acids in addition to the saturated acids they contain. Soliven [6] reported 35.21 per cent oleic and 49.28 per cent linolic acid in the mixed acids. Kafuku, Hata, and Fujikawa [7] found that the total mixed acids contained 53.20 per cent oleic and 22.80 per cent linolic acid. Experiments performed by Francois and Droit [8] indicated that the mixed acids have about three and a half times as much oleic as linolic acid.

From the inconsistent data recorded in the literature it is evident that the exact composition of physic-nut oil is still an open question.

EXPERIMENTAL PROCEDURE

The physic-nut seeds used in this investigation were collected near Magalang, Pampanga Province, Luzon. They were found to have 34.3 per cent of hulls and 65.7 per cent of kernels. A sample of the kernels extracted with ether gave 46.5 per cent of oil, hence the oil in the whole seeds amounted to 30.6 per cent. The seeds had a moisture content of 20.0 per cent; calculated on a moisture-free basis the whole seeds contained 38.2 per cent of oil.

When tested in the Bureau of Science by the Division of Tests and Standards the hulls gave a heating value of 4,653 calories per gram. This is somewhat higher than the result obtained for common Philippine firewood which gave 4,633 calories per gram.

The physic-nut oil, obtained by cold-pressing the crushed kernels, was filtered to eliminate most of the solid material. The

[4] Grimme, L. I. C., Zeit. deut. Oel-Fett-Ind. 41 (1921) 513. Anon., Bull. Imp. Ins. 19 (1921) 288. L., Mat. grasses 14 (1922) 6099. Soliven, F. A., Philip. Agr. 16 (1928) 587. Smith, T. J., Chemist and Druggist 112 (1930) 746. Kafuku, V. K., C. Hata, and M. Fujikawa, Journ. Chem. Soc. Japan 53 (1932) 1115. Droit, S., Bull. mat. grasses inst. colonial Marseille 16 (1932) 270. Francois, M. T., and S. Droit, Bull. Soc. Chim. 53 (1933) 728; 1564. Adriaens, L., Mat. grasses 28 (1936) 10786; 10813.

[5] Chemical Technology and Analysis of Oils, Fats, and Waxes 2 (1922) 241.

[6] Philip. Agr. 16 (1928) 593.

[7] Journ. Chem. Soc. Japan 53 (1932) 1115.

[8] Bull. Soc. Chim. 53 (1933) 728.

oil was then purified by treating successively with 2 per cent kieselguhr, suchar, and talcum powder. This treatment removes vegetable fibers and colloidal matter and produces a brilliantly clear oil that is only slightly yellow.

The oil cake that remains after expelling the oil cannot be used as cattle food because it contains a purgative substance that is toxic. Analysis [9] gave the following results (Table 1).

TABLE 1.—*Composition of physic-nut oil cake.*

Constituent.	Per cent.
Moisture	6.63
Ash	8.87
Oil	14.14
Protein	49.90
Crude fiber	3.45
Carbohydrates (by difference)	17.01

In Table 2 is given the fertilizer value [10] of physic-nut oil cake. It has a high value as a fertilizer and is about as rich in nitrogen and phosphorus as castor-seed cake.

TABLE 2.—*Fertilizer constituents in physic-nut oil cake.*

Constituent.	Per cent.
Nitrogen (N_2)	8.23
Phosphoric anhydride (P_2O_5)	4.71
Potash (K_2O)	0.25
Moisture	8.05

The physical and chemical constants of physic-nut oil are given in Table 3.

TABLE 3.—*Physical and chemical constants of physic-nut oil.*

Specific gravity at 30°/4° C.	0.9082
Refractive index at 30° C.	1.4665
Iodine number (Hanus)	94.8
Saponification value	192.4
Unsaponifiable matter (per cent)	0.45
Acid value	5.1
Saturated acids, determined (per cent) [a]	17.37
Unsaturated acids plus unsaponifiable matter, determined (per cent)	77.90
Saturated acids, corrected (per cent)	16.82
Unsaturated acids, corrected (per cent) [b]	78.00
Iodine number of unsaturated acids	111.00

[a] Due to the incomplete separation by the lead-salt-ether method the saturated acids, as determined, contained 0.55 per cent unsaturated acids.

[b] Corrected for unsaponifiable matter and also for the percentage of unsaturated acids contained in the saturated acids.

[9] Analysis was made by Miss Gloria Cortes of the Bureau of Science.

[10] Analysis was made by Mr. R. Isidro of the Philippine Soil Surveys.

The saturated and unsaturated acids that occur as glycerides in Philippine physic-nut oil were separated by the lead-salt-ether method [11] in accordance with the suggestions of Baughman and Jamieson.[12] The results are recorded in Table 4.

TABLE 4.—*Separation of saturated acids from the unsaturated acids in Philippine physic-nut oil by the lead-salt-ether method.*

Experiment No.	Oil used.	Unsaturated acids.	Saturated acids.	Unsaturated acids (determined).	Saturated acids (determined).	Unsaturated acids (corrected).[a]	Saturated acids (corrected).
	g.	*g.*	*g.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
1	18.0477	14.1066	3.1020	78.16	[b] 17.18	78.20	16.69
2	17.1276	13.2985	3.0067	77.64	17.55	77.79	16.95
Mean				77.90	17.37	78.00	16.82

[a] Unsaturated acids (unsaponifiable matter) removed; iodine number (Hanus) 111.0.
[b] Iodine number (Hanus) 3.2.
[c] Iodine number (Hanus) 3.8.

Unsaturated acids.—The unsaturated acids separated from physic-nut oil by the lead-salt-ether method were treated with bromine and converted into their bromo-derivatives.[13]

No ether-insoluble hexabromide was obtained, thus showing the absence of linolenic acid. The composition of the mixed unsaturated acids, which occur as glycerides in physic-nut oil, was calculated from the iodine number of the unsaturated acids. The results are recorded in Table 5. There are also included the calculated percentages of glycerides corresponding to these individual unsaturated acids.

TABLE 5.—*Composition of the unsaturated acids of physic-nut oil and the glycerides corresponding to these acids.*

Acid.	Mixture of unsaturated acids.	Original oil.	Glycerides in original oil.
	Per cent.	*Per cent.*	*Per cent.*
Linolic	22.89	17.85	18.65
Oleic	77.11	60.15	62.86
Total	100.00	78.00	81.51

[11] Lewkowitsch, J., Chemical Technology and Analysis of Oils, Fats, and Waxes 1 (1921) 556.

[12] Cotton Oil Press 6 No. 1 (1922) 41. Journ. Am. Chem. Soc. 42 (1920) 2398.

[13] Lewkowitsch, J., Chemical Technology and Analysis of Oils, Fats, and Waxes 1 (1921) 585.

Saturated acids.—The saturated acids were separated from physic-nut oil by the lead-salt-ether method and esterified with methyl alcohol. The mixed acids were dissolved in methyl alcohol and saturated with dry hydrogen chloride gas. The mixture was then heated on a water bath (reflux) for fifteen hours, after which it was treated with water and the ester layer separated. The esters were dissolved in ether and the ethereal solution washed with sodium carbonate solution and afterwards with water. The ethereal solution was dehydrated with anhydrous sodium sulphate, filtered, and the ether removed by distilling. The impure esters which were yellow, were distilled under diminished pressure. A preliminary distillation at 5 millimeters pressure was made. The esters were redistilled at 4 millimeters pressure. Data on the distillation of the esters are given in Tables 6 and 7.

TABLE 6.—*First distillation of the methyl esters of the saturated acids; pressure 5 millimeters; 96.9878 grams of esters distilled.*

Fraction.	Temperature.	Weight.
	°C.	g.
A	174–177	16.1691
B	177–180	36.5653
C	180–183	15.2844
D	183–186	11.0956
E	186–194	9.5761
F	194–204	6.3588
Residue		1.7400
Total		96.7893

TABLE 7.—*Second distillation of the methyl esters of the saturated acids; pressure 4.0 millimeters; 96.7893 grams of esters redistilled.*

Fractions.		Temperature.	Weight.
From first distillation.	Second distillation.		
		°C.	g.
A and B	1	170–173	19.0076
C	2	173–176	20.5963
D	3	176–179	16.6208
E	4	179–182	10.4567
F and residue	5	182–185	15.6619
	6	185–188	7.9899
	7	188–204	5.2426
	Residue		0.6512
Total			96.2270

In Table 8 are given the analyses of fractions obtained in the second distillation of methyl esters. From these data there were calculated the amounts of the individual acids corresponding to the methyl esters contained in the various fractions. The results are recorded in Table 9 and were computed in accordance with the procedure used by Baughman and Jamieson [14] in their investigations of vegetable oils.

TABLE 8.—*Analyses of fractions obtained in the second distillation of the mixed methyl esters.*[a]

Fraction.	Iodine number.	Saponification value.	Mean molecular weight of mixed esters.	Composition of mixed esters.		Mean molecular weight of saturated esters.
				Saturated.	Unsaturated.	
				Per cent.	*Per cent.*	
1	2.0	209.5	267.8	98.11	1.89	267.3
2	2.9	207.4	270.5	97.26	2.74	269.8
3	5.0	202.4	277.2	95.27	4.73	276.4
4	7.3	199.8	280.8	93.09	6.91	279.7
5	9.5	193.9	289.3	91.01	8.99	288.7
6	10.2	191.0	293.7	90.35	9.65	293.6
7	9.7	185.9	301.8	90.82	9.18	302.4

[a] Calculated iodine number of unsaturated methyl esters 105.7; calculated saponification value of unsaturated methyl esters 189.8.

TABLE 9.—*Saturated acids corresponding to methyl esters in each fraction.*

Fraction.	Acid.							
	Myristic.		Palmitic.		Stearic.		Arachidic.	
	Per cent.	*g.*	*Per cent.*	*g.*	*Per cent.*	*g.*	*Per cent.*	*g.*
1	9.89	1.8800	83.07	15.7896				
2	1.63	0.3357	90.58	18.6561				
3			70.65	11.7426	19.79	3.2893		
4			58.64	6.1318	29.78	3.1140		
5			29.59	4.6344	57.00	8.9273		
6			14.38	1.1489	71.65	5.7248		
7					73.88	3.8732	12.73	0.6674
Residue [a]								0.6233
Total		2.2157		58.1034		24.9286		1.2907

[a] Residue assumed to be methyl arachidate.

[14] Journ. Am. Chem. Soc. 42 (1920) 156; 1197.

Table 10 gives the composition of the mixed saturated acids and the glycerides in the original oil corresponding to these acids.

TABLE 10.—*Saturated acids.*

Acid.	Mixture of saturated acids.[a]			Glycerides in original oil.
	Weight.	Composition.	Proportions in original oil.	
	g.	*Per cent.*	*Per cent.*	*Per cent.*
Myristic	2.2157	2.56	0.43	0.45
Palmitic	58.1034	67.14	11.29	11.84
Stearic	24.9286	28.81	4.85	5.07
Arachidic	1.2907	1.49	0.25	0.26
Total	86.5384	100.00	16.82	17.62

[a] When separated from physic-nut oil the corrected percentage of saturated acids was 16.82.

The composition of Philippine physic-nut oil is recorded in Table 11. As shown by the data the oil consists principally of oleic, linolic, and palmitic glycerides. The amount of oleic glyceride is remarkably large. This oil is suitable chiefly for making soap.

The theoretical saponification value of physic-nut oil, calculated from our results, is 191.2. The saponification value as determined by experiment was found to be 192.4. The calculated value checks very well with the experimental result.

TABLE 11.—*Composition of Philippine physic-nut oil.*

Constituent.	Per cent.
Glycerides of:	
Unsaturated acids—	
Oleic	62.86
Linolic	18.65
Saturated acids—	
Myristic	0.45
Palmitic	11.84
Stearic	5.07
Arachidic	0.26
Unsaponifiable matter	0.45
Total	99.58

SUMMARY

Jatropha curcas is a small tree that is grown in the Philippines and usually cultivated in and about towns to serve as a hedge plant.

The oil obtained from the seeds of this tree is known as physic-nut oil. When taken internally it has strong purgative properties and in some countries it has been used medicinally. It has also been employed for making soap and as an illuminant.

Physic-nut oil consists principally of glycerides of oleic, linolic, and palmitic acids. The amount of oleic glyceride contained in the oil is remarkably large.

ILLUSTRATIONS

PLATE 1

Physic-nut tree (*Jatropha curcas* Linn.), growing near Manila.

PLATE 2

Physic-nut capsules.

PLATE 3

FIG. 1. Physic-nut flowers.
2. Mature physic-nut seeds (natural size).
3. Physic-nut capsule opened showing seeds.

PLATE 1.

PLATE 2.

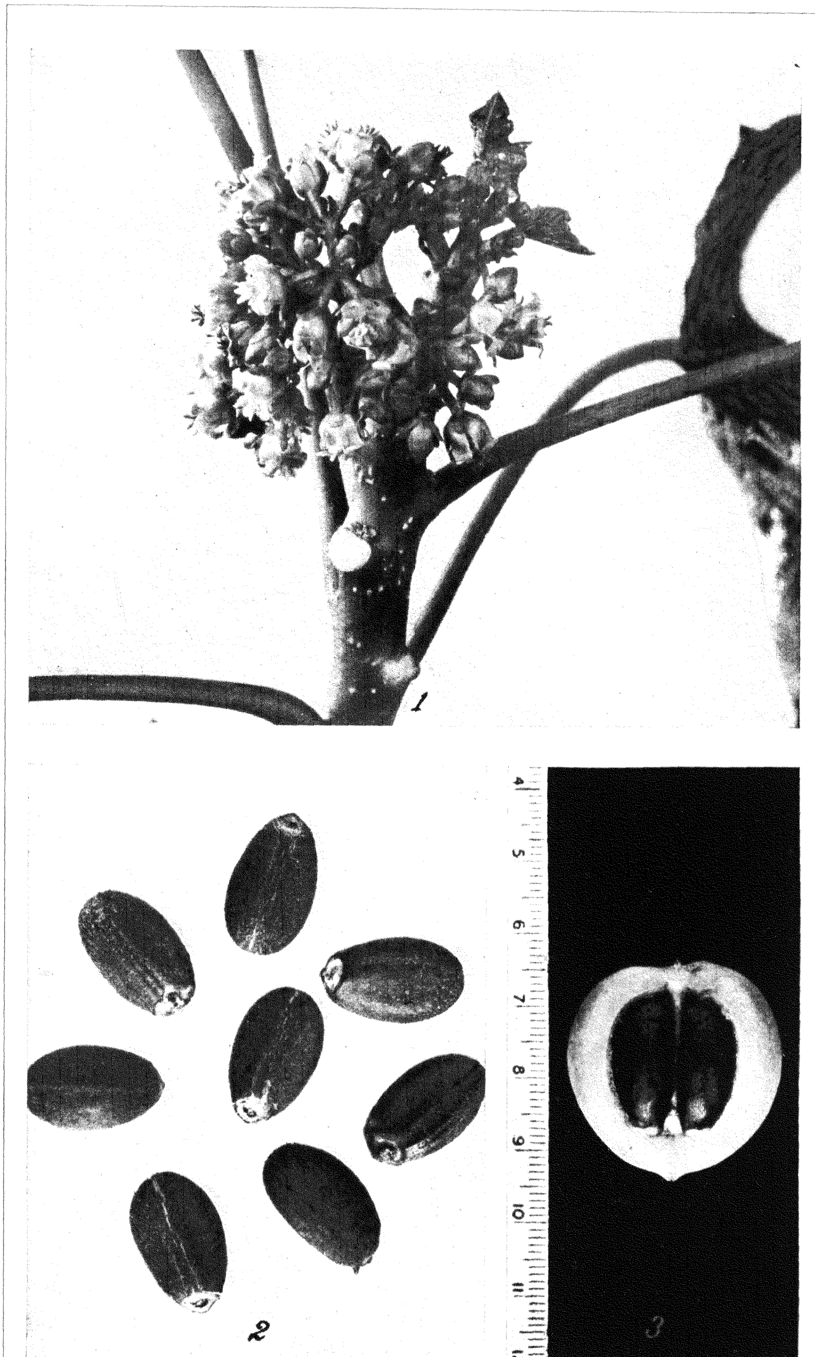


PLATE 3.

AN IMPROVED JONES REDUCTOR

By ROLLIN G. MEYERS
Chemist, United States Navy Yard, Cavite, Philippine Islands

ONE PLATE

The recent use of fretted glass instead of asbestos for filtration, as for example in the Gooch crucible, suggested the idea of applying it to the Jones reductor for iron determinations.

Whether the ordinary form of the Jones reductor is used, or, better, the design favored by Hillebrand and Lundell,[1] some pad near the bottom of the tube must be provided; for it is necessary to hold the column of 20-mesh zinc securely in the reductor and prevent any of the metal from being carried into the suction flask. Filter plates do not always fit securely, and usually the construction of this pad requires some little time. To avoid these objectionable features there is substituted an integrated, fretted-glass filter pad. The pad should be of sufficient compactness to retain the zinc particles but not too dense to retard the passage of the solutions through the reductor.

The design of the reductor (Plate 1) shows the position of the fretted-glass filter pad, and is similar in general features to that favored by Hillebrand and Lundell, but differs in that the main stopcock is placed at the left instead of the right. This change it is believed facilitates the manipulation by permitting an easier use of both hands when the main and lateral stopcocks are used at the same time. The dimensions given in the drawings are tentative.

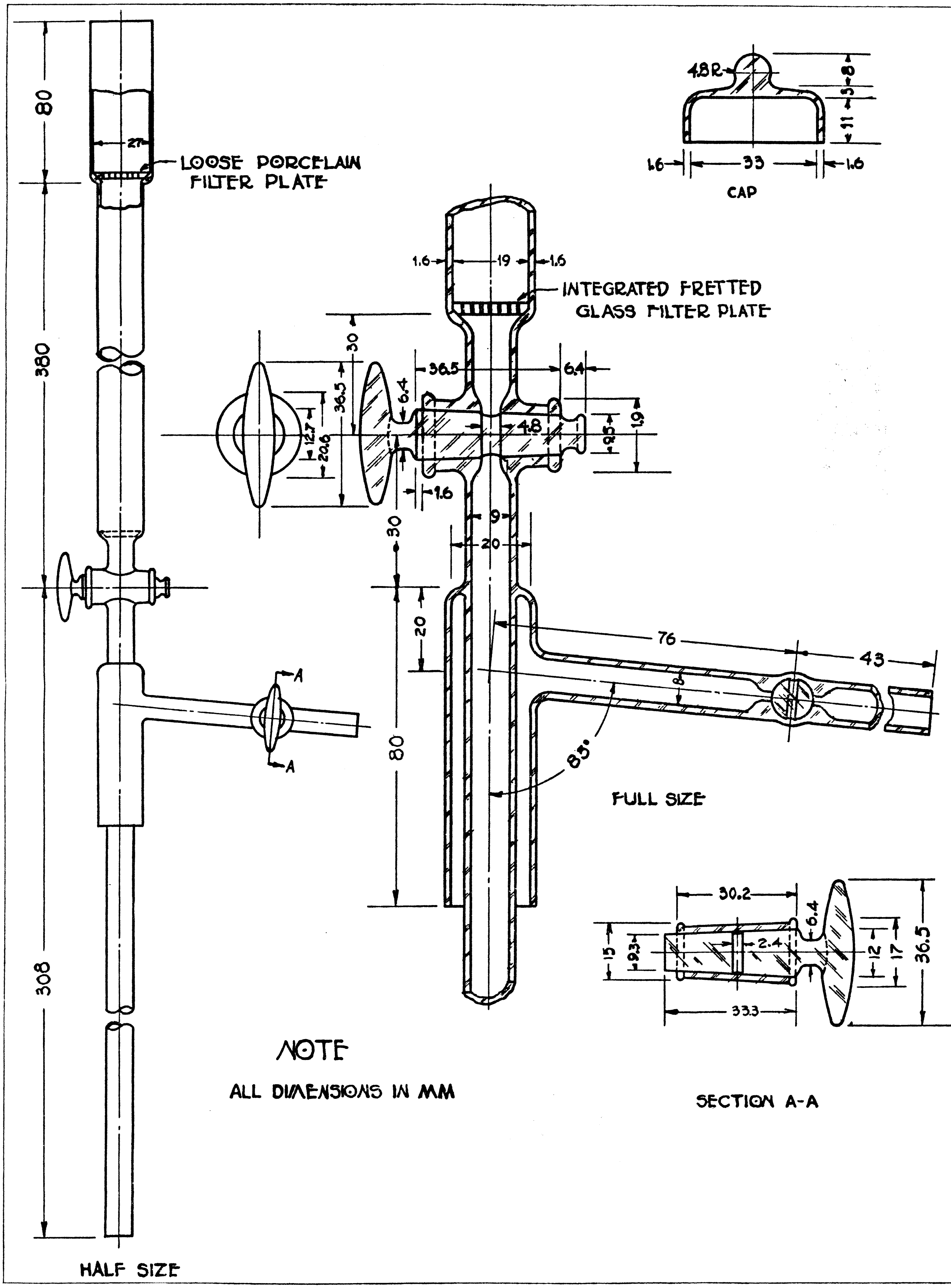
[1] Applied Inorganic Analysis (1934) 100.

ILLUSTRATION

PLATE 1

FIG. 1. Jones reductor with Meyers modification of integrated fretted-glass filter plate. About 0.4 actual size.

2. Detailed view of the fretted-glass filter and stopcocks. About 0.8 actual size. Dimensions are in millimeters on both figures.



80
380
308
27
LOOSE PORCELAIN FILTER PLATE
HALF SIZE
A
A
4.8R
8
3
11
1.6
33
1.6
CAP
1.6
19
1.6
INTEGRATED FRETTED GLASS FILTER PLATE
30
36.5
6.4
36.5
6.4
12.7
20.6
4.8
9.5
19
1.6
9
20
30
20
80
76
43
8
85°
FULL SIZE
30.2
6.4
15
9.3
2.4
12
17
36.5
33.3
SECTION A-A
NOTE
ALL DIMENSIONS IN MM

PLATE 1.

FLORAL MECHANISM IN STERCULIA APETALA (JACQUIN) KARSTEN [1]

By José B. Juliano
Of the College of Agriculture, University of the Philippines, Los Baños

and

Eduardo Quisumbing
Of the Bureau of Science, Manila

FOUR PLATES

One of the most interesting and fascinating problems in botany is the peculiar biological behavior of floral organs of many angiosperms. Some of these flowers possess structures well adapted to insure pollination, while others almost lack the structural and peculiar organization essential to reproduction. Several imported shade trees, *Sterculia apetala* (Jacq.) Karsten (*S. carthaginensis* Cav.), now growing at the College of Agriculture, University of the Philippines, Los Baños, Laguna, have been producing an abundance of flowers each year for several years, and surprisingly enough few fruits or none have developed from them after any blooming period. Because of this apparent paucity of the fruits any observation on the floral behavior is of interest and worthy of record.

This large, graceful, and stately tree (Plate 2) is a native of Panama(4) and is found from southern Mexico to the West Indies and northern South America.[2] It is known there as *panama;* in Guatemala, Salvador, and Honduras, *castaño;* in Tabasco, *bellota;* in Columbia, *camajon;* and in Cuba, *camaruca.*

Its leaves are large, deciduous, digitately 3- to 5-lobed, more or less peltate, coriaceous, shining green above and soft stellate-tomentose below. Shedding of its leaves usually takes place in the middle or even as late as the later part of January and lasts for a month or so. Simultaneous with the shedding of its leaves, new leaf initials are formed at the apices of the branches. At

[1] Experiment station contribution, No. 1145. Read before the Los Baños Biological Club, September 24, 1936.

[2] The writers have failed to determine the exact date of introduction of these trees on the campus from the records of the Department of Agronomy, College of Agriculture.

the axils of the juvenile leaves, inflorescence initials are differentiated at the four to five basal young leaves. Active growth of the leaf and inflorescence initials takes place only when all of its leaves are nearly shed (Plate 3), this lasting for about a week or so, whence the tree regains its former verdure and the inflorescences become well developed (Plate 4).

The inflorescence, which is axillary, is a large, spreading panicle, bearing numerous pedicellate, bell-shaped, polygamous (andromonœcious) flowers. The hermaphrodite, or perfect, flowers (Plate 1, fig. 8), are less in number than the males (Plate 1, fig. 9) and are the first to mature. Neither flower possesses distinct petals or sepals, and instead each is provided with a 5-lobed, bell-shaped perianth, studded with pinkish to reddish woolly shaggy hairs on the outside, and villous within. Sometimes the perianth may be reddish and woolly inside, dark red and greenish yellow without. Each flower usually measures from 1.8 to 2.5 centimeters in diameter, and is provided with a terete pedicel about 0.8 to 1.2 centimeters in length. At the central inner portion of the perianth surrounding the stalk, which bears either the pistil and stamens or stamens alone, is a yellowish circular disc whereon deposits of droplets of nectar can be detected before anthesis, and these attract insects during the early forenoon.

In the hermaphrodite flower the stipitate pistil is hairy, 4- or 5-carpelled, 4- or 5-celled; style connate; stigma radiate. The anthers are borne in groups of two or three on a ring around the base of the ovary (Plate 1, figs. 10–12) and are more or less provided with very short stubby filaments. The anthers are bilobed, and dehiscence is longitudinal.

The staminate flower, which develops much later than the hermaphrodite, is provided with a terete hairy stalk borne at the center of the perianth and is enlarged at its apex, whereon the anthers are borne on a common disc (Plate 1, fig. 9). Surrounded by the anthers and usually inconspicuous is a rudimentary pistil.

The fruit, which seldom sets, is borne in a cluster of five podlike carpels, about 10 centimeters long and contains large brown chestnutlike seeds. Its interior is covered with stiff brown bristles that may penetrate the flesh and may cause irritation.

The trees on the College of Agriculture campus were first observed by the writers to bloom in March, 1924. Earlier blooming might have taken place, as a herbarium collection deposited in the National Museum Division, Bureau of Science, shows that

Mr. J. E. Higgins, formerly a professor of agronomy of the College of Agriculture, collected specimens of this species with mature inflorescence March 4, 1922. As far as the writers are aware this is the earliest record of the blooming of this species on the campus. Opportunities for observing the floral behavior of this species offered themselves during 1925, 1926, and 1931.

Anthesis.—March 25 and 26, 1925, and March 1 and 2, 1926, hourly observations were made on the opening of the male and perfect flowers for a period of twenty-four hours. During each observation eighty flowers of each kind were studied.

The mode of opening and separation of the perianth lobes in both flowers is perfectly identical. Long before anthesis, the perianth lobes are intact (Plate 1, fig. 7) at their margins and seem to be so well fitted together as to be nearly air-tight. This is indicated by the slight puffing action when a slight pressure is applied on the perianth. Separation of the perianth lobes usually begins at about 10.45 to 11 p. m. Small slits between the lobe margins are formed (Plate 1, fig. 1) simultaneously, usually starting at the middle where the opening is the widest. Sometimes slit formation takes place between two opposing margins of the lobes (Plate 1, fig. 2), so that the lobes become separated into one group of two lobes and another with three lobes. Between 1.07 and 1.25 a. m. the third slit is formed (Plate 1, fig. 4) separating one of the lobes from the group of three. Sometimes, a fourth slit is simultaneously formed so that three lobes become distinctly separated, while the two still remain intact (Plate 1, fig. 5). When slits are formed simultaneously between the lobes (Plate 1, fig. 1) early at night (10.45 to 11 p. m.), we obtain a condition similar to that shown in Plate 1, fig. 3, where three of the lobes remain intact only at their apices, while the other two touch each other only at their apices. These conditions remain throughout the early morning, and at about 4 to 4.15 a. m. all of the lobes separate from one another completely (Plate 1, fig. 6) and begin to curve outward very slowly until the perianth segments are actually distended and curved outward, thus exposing the sexual organs at 5 a. m. or at dawn. Anthesis is accompanied by an exhalation of a characteristic odor, which attracts insects and lasts practically the whole day. In other words, the perianth lobes begin to separate at about 11 p. m. and are completely distended at 5 a. m., a period covering practically six hours. In no case did the writers observe a single flower remaining closed; all of them (male and hermaphrodite) opened.

Movement of the pistil.—Movement is essentially confined to the stalk bearing the pistil and the stamens or the stamens and the rudimentary pistil, and to the style of the pistil in the hermaphrodite flower.

When the hermaphrodite flower has attained a diameter of about 7 to 8 millimeters, its pistil and stamens inclosed by the perianth segments (Plate 1, fig. 7) are very well differentiated and developed. Its pistil is borne on a very short, stubby, terete stalk arising from the center of the perianth. As the flower develops and enlarges, this stalk elongates (Plate 1, fig. 8) vertically, thus pushing the stigmas way down against the apices of the perianth lobes. This elongation is accompanied by an unequal growth or elongation of the cells of the stalk on one side, which results in the bending of the same stalk. This combined elongation and bending of the stalk is completed prior to 9 p. m., the night before anthesis. On the other hand, the style begins to elongate and bend early in the morning (8 a. m.), the day prior to anthesis, and continues to do so until 3 p. m. of the same day, at which time the style assumes a nearly horizontal position (Plate 1, fig. 11). Bending of the style and the stalk, therefore, must have started more than fifteen hours before anthesis when the sexual organs are fully exposed. The pistil retains this position through the night until about 4 a. m. the next day, when another active bending takes place in the style alone. This further growth of the style keeps it nearly touching the carpel wall of the ovary (Plate 1, fig. 12) and the stigmas directed towards the pedicel. The style, therefore, has two periodic movements; during and after the first movement the stigmas may be placed in such a position that a slight chance for self-pollination, or autogamy, may be attained, although, as is noted below, this seems to be improbable.

The movement of the stalk of the male flower is very similar to that described for the hermaphrodite flower. In this the elongation and curvature of this stalk is much more pronounced (Plate 1, fig. 9) so that at anthesis the anthers are placed in a nearly oblique position facing the perianth. No movement of the rudimentary pistil has been noted.

Dehiscence.—Dehiscence of the pollen grains was observed for three years (1925, 1926, and 1931) and was found to take place between 1 and 2 a. m. The anthers never dehisce their contents all at one time; they open one after another in no regular succession for a period of an hour. It is very interesting to note that dehiscence takes place at the time when the stigmas are

held nearly horizontal (Plate 1, fig. 11), so that pollination, or autogamy, even by gravity, is rather difficult, if not impossible. The direct line of fall of the pollen grains does not coincide with the position of the stigmas so that pollen grains would rarely lodge on the stigmas. Protrandry is the rule in this species as dehiscence takes place long before complete anthesis is attained.

Emasculation.—To ascertain whether the bending of the style and the stalk is influenced by the presence of the stamens at the base of the ovary in the perfect flower, one hundred hermaphrodite flowers were emasculated in March, 1926, and 1931, at 8 a. m., before the styles had a chance to show any sign of movement. For emasculation flowers that were expected to open the next morning were selected. With a slight pressure applied on the perianth, the lobes were mechanically separated from one another, and a pair of fine forceps was inserted into the perianth. The anthers were removed carefully, one by one, care being taken to dip the forceps in ethyl alcohol (95 per cent) every time a stamen was removed from a flower. Beginning at 9 o'clock that night, hourly observations were made on the behavior of the styles and stalks of the emasculated flowers; the results are interesting. The stalks bearing the pistils elongated and bent as described above, but their styles never changed their positions for twenty-four hours from 9 p. m., these remaining perpendicular to the axis of the ovary. None of the emasculated flowers produced fruits; they shriveled and dried, remaining on the floral cluster for some time until the whole inflorescence abscinded from the tree. It seems very likely that some direct relation really exists between the bending of the styles and the presence of stamens at the bases of the ovaries, but not with the elongation and bending of the stalks bearing the pistils. The presence of stamens serves perhaps as a stimulus for such movement of the style.

The writers believed that gravity might play a part in the bending of the style in this species. March 1, 1931, two large branches bearing numerous flowers or floral clusters were tied to a long wooden pole so as to change the normal position of the individual flowers. This was done at 8 a. m. The relative positions of one hundred perfect flowers were noted and recorded; some were held in an inverted position, while others were held laterally. Hourly observations were made on these flowers for a period of twenty-four hours. The young flower buds (mostly males) that did not open the next morning were decapitated, while fifteen were allowed to remain as controls.

Only five of the hermaphrodite flowers held laterally showed bending of their styles; the styles of those that were turned upside down exhibited no movement at all, but remained vertical with the stigmas directed upward as before. The young male flowers used as control were able to change their position and assumed the normal pendant position the next morning. Although the data herein presented on the influence of change of position on the movement of the styles seem insufficient, there are indications to show that gravity has little or nothing to do with the bending of the styles.

It is clearly evident that self-pollination here may be inadequate because of the nonsynchronous movements of the style and stalk with the time of dehiscence. Cross-pollination may be possible though, because of the possibility of pollen transfer by insects during the early morning when the stigmas are still receptive. In many species of angiosperms movements of the style or stigma and stamens bring about autogamy and pollination very successfully. Knuth,(2) for example, cites *Epilobium angustifolium* Linn. as having flowers with styles short at first; later, after twenty-four hours from anthesis, these elongate, and the widely divergent stigmas finally recurve so as to touch the pollen-covered anthers. In *Oenothera biennis* Linn. the style straightens half an hour after anthesis, and the stigmas spread out, so that crossing may be effected by insects already dusted with pollen. As the four stigmas roll back they ultimately touch the anthers before these have lost their pollen. In *Stachys sylvatica*(3) the style, at first with almost apposed branches, is situated behind the anthers, which have dehisced downward. Later the style bends downward under the anthers and, at the same time, opens its branches widely. If insects fail to visit the flower, autogamy is effected by the stigmatic branches, which slide gradually between the anthers that are still covered with pollen, or the stigmatic branches bend downward until they touch the anthers. Similar movements of the styles in *Valerianella olitoria* Pollich., *Morina elegans* Fisch. and Avé-Lall., and *Tricyrtis pilosa* Wall. also effect autogamy.

Hildebrand(1) observed that the movement of the floral organs in *Cleome spinosa* and *C. gigantea* was due to gravitation. He further states that as the position of the floral organs in this respect is altered, the stigmas and the anthers always assume such positions that they do not come in contact with one another, and cross-pollination is promoted.

Knuth(3) also mentions that the movements of the stamens of *Berberis vulgaris* Linn. are caused by the flow of water in the stimulated part. The stamens bend inward towards the stigma due to the presence of a special tissue, consisting of elongated narrow cells which are almost fused together and provided with small intercellular spaces, especially at their ends. The transverse walls of these cells are thin, and their longitudinal walls, on the contrary, are thick with numerous scattered pits which render possible both a very rapid interchange between cells and also a quick bending of this elastic tissue. On stimulation, the stamen becomes lax, spreads out, curves like a bow, while its edges pull upon the transverse walls, and its convex central part presses against the outer wall, which becomes strongly arched. Hence, the cells become shorter and thicker. This change in the motile tissue causes the filaments to bend inward.

Artificial pollination.—In March, 1926, artificial pollination of one hundred hermaphrodite flowers was performed by the writers. The pollen was collected between 1 and 2 a. m. from normal male flowers with the use of a camel's hair brush. The pollen grains were gently brushed against the stigmas of the perfect flowers that were to open that same morning. This was repeated in March, 1931. Of the one hundred flowers thus artificially pollinated, only two developed fruits in 1926, and only one in 1931. These results clearly indicate two possibilities; namely, that the nonsetting of fruits may be due to lack of proper pollination or to the presence of defective pollen, defective ovular contents, or similar conditions inherent in the plant. The writers have no information to offer on this matter.

Insect visitors.—As fruit setting is rather rare, it seemed in order to find out what kind of insects usually visit the flowers. March 1, 1926, several insects were observed flying from flower to flower. Some of the insects that were found between 8 to 10 a. m. were *Erassa penangæ* Moore (a moth), *Trigona biroi* Fabr., *Monolepta bifasciata* Hornst. (a beetle), and *Cantharis granulipennis* Blanchard (a beetle).[3] During the afternoon, from 3 to 5 p. m., the following insects were the frequent visitors: *Erassa penangæ* Moore, *Trigona biroi* Fabr., and *Lucilia dux* Linn. (a fly). In the evening only moths and flies visited

[3] The identification of these insects was made by Dr. Leopoldo B. Uichanco, of the College of Agriculture, to whom the writers are greatly indebted.

the flowers, and their activities seemed to stop after 8 p. m. Throughout the whole night practically no other insects visited the flowers.

March 10, 1931, another observation on insect visitors was made by the writers. The day was bright and clear, and the plant was in full bloom. The insects observed are listed in Table 1.

TABLE 1.—*Insects that visited flowers of Sterculia apetala March 10, 1931, from 7 a. m. to 12 noon and from noon to 4.15 p. m.*

	7 a.m. to 12 noon.	12 noon to 4.15 p. m.
Apis indica Fabr., race *nigrocincta* Smith (Apidæ, Hymenoptera)	−	+
Chalcididæ, Hymenoptera (parasitic wasp)	+	+
Cantharis flavifemoralis Blanchard (Coleoptera)	+	−
Chilomenes 6-maculata Fabr. (Coccinelidæ, Coleoptera)	+	+
Chalcididæ, Hymenoptera (wasp)	+	+
Ceratia similis Oliver (Chrysomelidæ, Coleoptera)	−	+
Dasyproctus philippinensis Ashmead (Crabronidæ, Hymenoptera)	+	−
Diacamma sp. (Formicidæ, Hymenoptera)	+	−
Dysdercus megalopygus Breddin (Pyrrhocoridæ, Hemiptera)	+	−
Dysdercus pœcilus H. S. (Pyrrhocoridæ, Hemiptera)	+	+
Mycetophilidæ, Diptera	+	−
Muscoidea, Diptera	+	+
Musca sp. (Muscidæ, Diptera)	−	+
Plecoptera	+	−
Polyrhachis dives Sm. (Formicidæ, Hymenoptera)	+	+
Phyllodromia sp. (Blattidæ, Orthoptera)	+	−
Odynerus hæmorrhoidalis var. *ater* Sauss. (Eumenidæ, Hymenoptera)	−	+
Reduviidæ, Hemiptera	−	+
Syrphidæ, Diptera	+	+
Tabanus striatus Fabr. (Tabanidæ, Diptera)	−	+
Tachinidæ, Diptera	+	+

At night, from 8 to 6 o'clock the next morning, no insect other than mosquitoes were observed to visit the flowers.

Of the insects enumerated above, the following are the only possible flower pollinators: *Apis indica* Fabr. race *nigrocincta* Smith., *Dasyproctus philippinensis* Ashmead, *Odynerus hæmorrhoidalis* var. *ater* Sauss., and possibly the Muscoidea (Diptera), *Musca* sp. and Syrphidæ (Diptera). These are mostly present during the early forenoon, while others may continue to visit the flowers even in the afternoon.

From the above observations it is apparent that insect visitors are rather numerous in the early morning and afternoon, and practically absent at night. As dehiscence takes place at the time when insect visitors are absent, this species is dependent largely, if not entirely, on autogamy for pollination. During the day when insects are numerous, the anthers are wholly, if not entirely, devoid of their contents, as their pollen grains have been dehisced by them. Of course, during the early morning hours when the stigmas are still receptive, a certain amount of cross-pollination may occur.

SUMMARY

Macroscopical observations on the floral behavior of *Sterculia apetala* (Jacq.) Karsten (*Sterculia carthaginensis* Cav.) are herein reported. The flowers (hermaphrodite and male) start to open at about 11 p. m. and are completely opened by 5 o'clock the next morning. Simultaneous elongation and bending of the stalk bearing the pistils and stamens as well as stamens alone have been noted. These movements may bring the stigma in the line of fall of the pollen grains, but since anthesis takes place at the time the stigmas have already passed this line, autogamy hardly occurs.

Insects visiting the flowers are abundant during the day and are practically absent at night, during which time anthesis takes place. Scarcity of fruits that are set during each blooming period may be attributed to the poor device for bringing about self-pollination in this species.

The presence of stamens on the ovary is believed to be the stimulus necessary for the movement of the style but not the stalk bearing the pistil. Gravity has very little, if any, influence on the movements of the style and stalk bearing the pistil.

Artificial pollinations disclosed the fact that the nonsetting of fruits may be due either to the lack of proper pollination or to the presence of defective pollen, defective ovular contents, and the like.

BIBLIOGRAPHY

1. HILDEBRAND, F. Die Beeinflussung durch die Lage zum Horizont bei den Blütentheilen einiger Cleome-Arten. Ber. d. Deutsch. bot. Gesells. 4 (1886) 329–337.
2. KNUTH, P. Handbook of Flower Pollination. Oxford 1 (1906) 382.
3. KNUTH, P. Handbook of Flower Pollination. Oxford 2 and 3 (1908–1909) 1347.
4. STANDLEY, P. C. Trees and shrubs of Mexico. U. S. Nat. Museum Contrib. 23[3] (1923) 517–848.

ILLUSTRATIONS

[The drawings were retraced by Mr. V. V. Marasigan, of the National Museum, Bureau of Science, from the original drawings of the senior author. The photographs were taken by the photographic division of the College of Agriculture.]

PLATE 1. STERCULIA APETALA (JACQ.) KARSTEN

FIG. 1. Front view of the hermaphrodite flower showing early formation of slits between the perianth lobes, collected at 10.45 p. m.; × 1.
2. The same as fig. 1, collected at 10.50 p. m.; × 1.
3. The same, collected at 1 a. m.; × 1.
4. The same, collected at 1.25 a. m.; × 1.
5. The same, collected at 1.30 a. m.; × 1.
6. Another flower showing all its lobes fully separated from one another, collected at 4 a. m.; × 1.
7. Young hermaphrodite flower with portion of its perianth removed to show the short stalk bearing the pistil, the ovary of which bears at its base the stamens; × 3.
8. Showing elongation of the stalk bearing the pistil and stamens in hermaphrodite flower; *pe*, perianth; × 3.
9. A mature male flower with a portion of its perianth, *pe*, removed to show the long, curved stalk bearing the anthers at its apex (rudimentary pistil not seen); × 3.
10. Showing the bending of the stalk bearing the pistil and stamens in the hermaphrodite flower; × 3.
11. Showing the anthers already dehiscing, while the style is held horizontally; *ov*, ovary; × 3.
12. At anthesis, showing the style, *se*, completely bent and the stalk fully bent and elongated; *pl*, pedicel; *sa*, stigmas. Note the wide dehiscence of the anthers, *st*; × 3.

PLATE 2. STERCULIA APETALA (JACQ.) KARSTEN

The plant in full foliage and in full bloom. Photographed March 17, 1926.

PLATE 3. STERCULIA APETALA (JACQ.) KARSTEN

The same tree nearly defoliated. Shows active growth of new leaf buds at the axils of which are formed the inflorescence initials at nearly the same time. A few old dry leaves still persist on the terminal branches. Photographed February 9, 1931. This tree was uprooted by a typhoon in 1935.

PLATE 4. STERCULIA APETALA (JACQ.) KARSTEN

Another tree of the same species growing near the administration building (north side) in full bloom and in full foliage. Abundant dried leaves on the ground. On the right is a stem of a young royal palm, and *Phytolaca dioica* Linn. on its extreme right. *Averrhoa bilimbi* Linn. is in the background between the *Sterculia* and the royal palm. Photographed March 30, 1926.

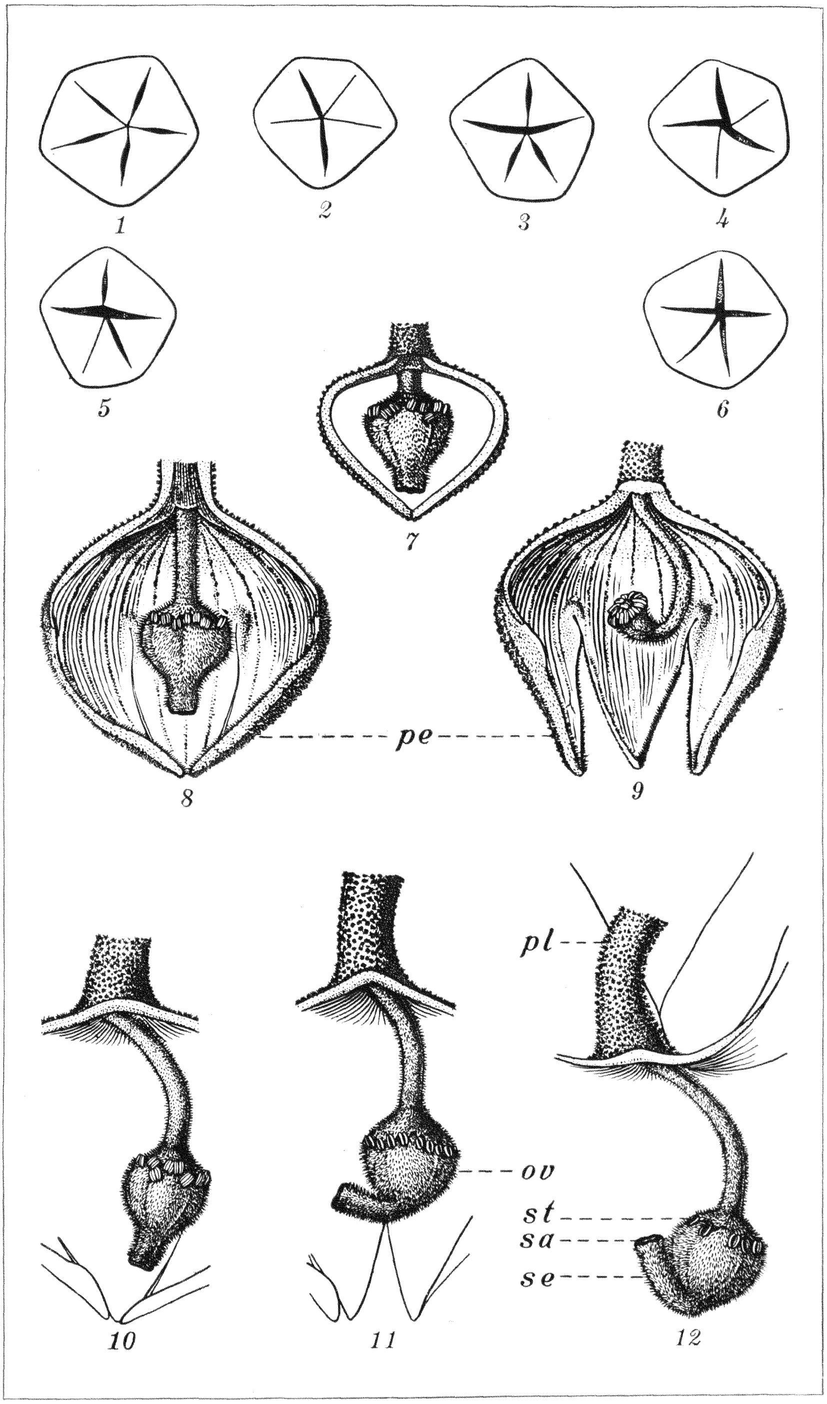


PLATE 1.

PLATE 2.

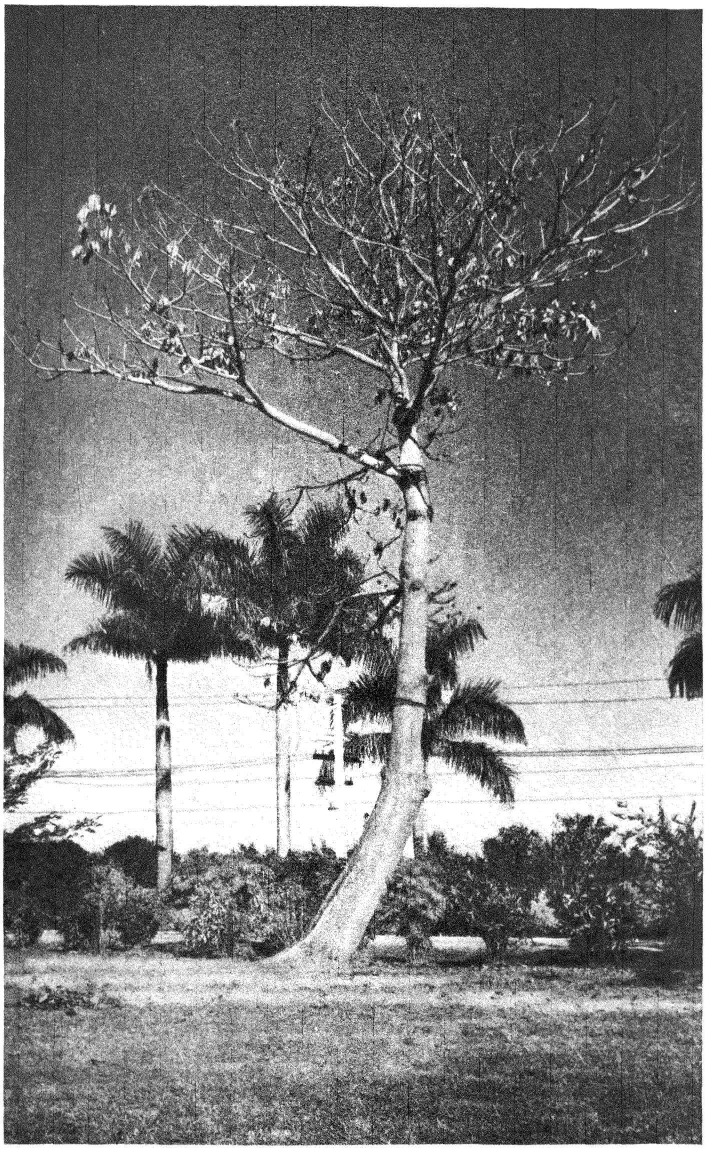


PLATE 3.

PLATE 4.

PHILIPPINE RUSTS IN THE CLEMENS COLLECTION 1923–1926, II[1]

By J. C. ARTHUR and GEORGE B. CUMMINS

Of the Department of Botany, Purdue University Agricultural Experiment Station, Lafayette, Indiana

FOUR PLATES

ON MORACEÆ

52. **CEROTELIUM ALLAEANTHI** Syd.

On *Allaeanthus luzonicus* (Blco.) F. Vill. var. *glaber* (Warb.) Merr., LUZON, Isabela Province, Cabagan, January 16, 1924, *Clemens 1697*.

53. **CROSSOPSORA FICI** sp. nov. Plate 2, fig. 3.

Urediis hypophyllis, subepidermalibus, minutis, brunneis, paraphysibus periphericis, hyphoideis; urediosporis irregularis, ellipsoideis, obovoideis vel triangularis, 16–19 x 19–30 μ; membrana 1.5 μ cr., cinnamomea, echinulata, poris germ. 3, aequatorialibus. Teliis hypophyllis, filiformis, brunneis, 2–5 mm longis; teliosporis oblongis, 7–10 x 23–30 μ; membrana 1 μ cr., pallide brunnea.

On *Ficus variegatus* Bl., LUZON, Zambales Province, Castillejos to Subic, March, 1924, *Clemens 1727*.

54. **PHYSOPELLA FICI** (Cast.) Arth.

On *Ficus Cumingii* Miq., LUZON, Benguet Subprovince, Mount Pulog and vicinity, February 24 to 27, 1925, *Clemens 5123*. On *Ficus hauili* Blco., LUZON, Bulacan Province, Sibul Springs, December, 1924, *Clemens 4947;* Benguet Subprovince, Adouay, February 24, 1925, *Clemens 5021;* Baguio highway, February, 1925, *Clemens 5812*. On *Ficus religiosa* L., LUZON, Manila, February 5, 1924, *Clemens s. n.* On *Ficus subulata* Bl., MINDANAO, Thermal Springs, Mount Apo, May 31, 1924, *Clemens 2031*. On *Ficus* sp., LUZON, Isabela Province, Ilagan, December 24, 1924, *Clemens 1812*. CEBU, Cebu, May 16, 1924, *Clemens 4921*. On *Malaisia scandens* (Lour.) Planch., LUZON, Isabela Province, Echague, December 19, 1923, *Clemens 1735*.

[1] Contribution from the Department of Botany, Purdue University Agricultural Experiment Station, Lafayette, Indiana.

55. UREDO ARTOCARPI B. and Br.

On *Artocarpus communis* Forst., MINDANAO, Todaya, Mount Apo, June 18, 1924, *Clemens 1979.*

ON URTICACEÆ

56. PUCCINIASTRUM PIPTURI Syd.

On *Pipturus arborescens* (Link) C. B. Rob., LUZON, Cagayan Province, Callao Caves, January 14, 1924, *Clemens 1721:* Benguet Subprovince, Mount Pulog and vicinity, February 24 to 27, 1925, *Clemens 5166.* On *Pipturus repandus* Wedd., LUZON, Nueva Vizcaya Province, south of Santa Fe, January 25, 1924, *Clemens 1691.*

It is doubtful whether this species can belong in the genus *Pucciniastrum.* The uredia have hyphoid, hyaline, peripheral paraphyses surmounting a very short and indistinct peridium. Such characters would indicate a relationship with *Cerotelium* rather than *Pucciniastrum.* In the absence of telia there can be no advantage in shifting the species about, however.

57. PUCCINIASTRUM BOEHMERIAE (Diet.) Syd.

On *Boehmeria multiflora* C. B. Rob., LUZON, Benguet Subprovince, Mount Santo Tomas, February 19, 1925, *Clemens 5810.* On *Cypholophus brunneolus* Elm., LUZON, Benguet Subprovince, Mount Santo Tomas, February 19, 1925, *Clemens 5809.*

58. UREDO sp.

On Urticaceæ (*Pilea?*), LUZON, Benguet Subprovince, Mount Pulog and vicinity, February 24 to 27, 1925, *Clemens 4986.*

Apparently this rust has not been described, but because of the uncertainty regarding the identity of the host and the fragmentary character of the specimen we are listing it as above. The uredia are amphigenous, erumpent, cinnamon-brown, with a few peripheral, brownish, thin-walled paraphyses; urediospores ellipsoid or globoid, 18 to 23 by 24 to 29 μ; wall 2 to 3 μ thick, cinnamon-brown, sharply echinulate, pores 2 and equatorial. The rust is probably a species of *Puccinia.*

ON POLYGONACEÆ

59. PUCCINIA CONGESTA B. and Br.

On *Polygonum chinense* L., LUZON, Benguet Subprovince, Mount Pulog and vicinity, February 24 to 27, 1925, *Clemens 5012.* On *Polygonum tomentosum* Willd., LUZON, Tarlac Province, Gerona, January, 1925, *Clemens 4951.*

60. **PUCCINIA POLYGONI-AMPHIBII** Pers.

On *Polygonum chinense* L., LUZON, Benguet Subprovince, Mount Pulog and vicinity, February 24 to 27, 1925, *Clemens 5125;* Baguio, February, 1925, *Clemens 5819, 5819a.*

Only uredia are represented in these collections. The spores have two or three pores near the hilum, as in the North American form on *Polygonum virginianum.*

ON ANONACEÆ

61. **AECIDIUM UVARIAE-RUFAE** P. Henn.

On *Uvaria rufa* Bl., LUZON, Bulacan Province, Santa Maria, November, 1924, *Clemens 4856.*

ON AMARANTHACEÆ

62. **UROMYCES DEERINGIAE** Syd.

On *Deeringia baccata* (Retz.) Moq., LUZON, Benguet Subprovince, Mount Pulog, below Camp 42, February 24, 1925, *Clemens 5030.*

ON RANUNCULACEÆ

63. **COLEOSPORIUM CLEMATIDIS** Barcl.

On *Clematis gouriana* Roxb., LUZON, Benguet Subprovince, between Camp 42 and Adouay, February 27, 1925, *Clemens 4988.*

64. **PUCCINIA EXHAUSTA** Diet.

On *Clematis gouriana* Roxb., MINDANAO, Todaya, Mount Apo, June 18, 1924, *Clemens 2002.* LUZON, Benguet Subprovince, Mount Santo Tomas, February 19, 1925, *Clemens 5814.*

ON BERBERIDACEÆ

65. **PUCCINIOSIRA CLEMENSIAE** sp. nov. Plate 2, fig. 2.

Pycniis ignotis. Aeciis et urediis nullis. Teliis hypophyllis, in greges maculis laxe dispositis, albido-flavis; cellulis peridii irregularis, oblongis, verrucosis, laxi conjunctis; teliosporis oblongis, 14–19 x 26–32 μ, utrinque rotundatis, medio leviter constrictis, levibus, facillime in loculos secedentibus, episporio 1–2 μ cr.; cellulis intercalaribus conspicuis.

On *Berberis barandana* Vid., LUZON, Benguet Subprovince, Mount Pulog, February 25 to 26, 1925, *Clemens 4974.*

We take great pleasure in naming this species in honor of Mrs. Clemens, whose botanical work in the Philippine Islands has resulted in many important discoveries.

ON LAURACEÆ

66. AECIDIUM MACHILI P. Henn.

On *Machilus philippinensis* Merr., LUZON, Benguet Subprovince, Mount Santo Tomas, February 19, 1925, *Clemens 5815.*

ON SAXIFRAGACEÆ

67. PUCCINIOSTELE CLARKIANA (Barcl.) Diet.

On *Astilbe philippinensis* Henry, LUZON, Benguet Subprovince, near Camp 42, en route to Mount Pulog, February 24, 1925, *Clemens 5028;* Mount Santo Tomas, February 19, 1925, *Clemens 5811a.*

ON ROSACEÆ

68. HAMASPORA ACUTISSIMA Syd.

On *Rubus moluccanus* L., MINDANAO, Thermal Springs, Mount Apo, May 31, 1924, *Clemens 2029.* On *Rubus niveus* Thunb., LUZON, Benguet Subprovince, Mount Pulog region, February 27, 1925, *Clemens 5130, 5131.* On *Rubus pyrifolius* Sm., MINDANAO, Thermal Springs, Mount Apo, May 30, 1924, *Clemens 2024.* On *Rubus Rolfei* Vid., LUZON, Benguet Subprovince, Mount Pulog, February 25, 1925, *Clemens 5135, 5136.*

69. KUEHNEOLA JAPONICI Diet.

On *Rosa philippinensis* Merr., LUZON, Benguet Subprovince, Adouay, February 24, 1925, *Clemens 4989.*

70. GERWASIA FASCICULATA sp. nov. Plate 2, fig. 1.

Pycniis et aeciis ignotis. Urediis epiphyllis, minutis, intraepidermalibus; urediosporis globosis vel ellipsoideis, 18–23 x 25–30 μ; membrana 2 μ crassa, hyalina, aculeata, poris germ. obscuris (3 aequatorialibus?). Teliis hypophyllis, minutis, pallidis, subepidermalibus, per stomata erumpentes; paraphysibus periphericis, hyalinis, valde curvatis, membrana crassa; teliosporis et paraphysibus in apice hypharum erumpentium ortis, teliosporis globosis vel ellipsoideis, 19–22 x 26–34 μ; membrana 1 μ crassa, ad apice 3 μ, hyalina, levis; pedicello brevi.

On *Rubus* sp., LUZON, Benguet Subprovince, Mount Pulog, February 25, 1925, *Clemens 5134.*

The telia of this rust are similar to those described for the genus *Gerwasia* in their mode of formation but differ in the curiously contorted nearly solid paraphyses. Because of the small size of the telia it is difficult to gain a clear conception of the base of the sorus, but it apparently originates beneath the epidermis and develops a slender stalk which passes through a stoma. Above the epidermis and at the apex of this stalk a

tangle of paraphyses is formed and among them the teliospores. Apparently the paraphyses and the teliospores are developed from the same stalk cell. The pedicels of the teliospores consist of one short cell. The uredia are formed in cavities in the hypertrophied epidermal cells.

Our attempts to obtain a specimen of *Gerwasia rubi* Racib. have proved futile. Nevertheless, we assign this new species to the genus *Gerwasia* rather than to *Mainsia* in the belief that the latter genus will prove to be synonymous with *Gerwasia*. A solution to the relationship of these peculiar rusts of *Rubus* will require a study of Raciborski's type, presumably to be found at the Botanical Institute, Jagellonian University, Krakow, Poland, or the rediscovery of the species.

71. UREDO sp.

On *Rubus Copelandi* Merr., LUZON, Benguet Subprovince, Mount Pulog, February, 1925, *Clemens 5132*. On *Rubus fraxinifolius* Poir., LUZON, Benguet Subprovince, between Adouay and Camp 42, February, 1925, *Clemens 5129;* Mount Pulog, February 24 to 27, 1925, *Clemens 5129a, 5129b;* Mount Santo Tomas, February 19, 1925, *Clemens 5825*.

Only uredia are present on these collections. The sori are subepidermal, small, yellowish, with abundant discal, incurved, thin-walled, hyaline paraphyses; urediospores ellipsoid, 13 to 17 by 17 to 22 μ, the wall 1 to 1.5 μ thick, colorless, very finely echinulate, with several scattered pores.

It has been impossible to place this *Uredo* with certainty. The uredia are much like those of *Phragmidium* or *Hamaspora*.

ON LEGUMINOSÆ

72. PUCCINIA PERIODICA Racib.

On *Derris heptaphylla* (L.) Merr., LUZON, Zambales Province, Olongapo, March, 1924, *Clemens 1729*. On *Derris polyantha* Perk., LUZON, Tarlac Province, La Paz, December 10, 1924, *Clemens 4885*.

73. UROMYCES MUCUNAE Rabh.

On *Mucuna sericophylla* Perk., LUZON, Isabela Province, ferry below Tumauini, December 25, 1923, *Clemens 1740*. On *Mucuna* sp., MINDANAO, Todaya, Mount Apo, May, 1924, *Clemens 2023;* June 15, 1924, *Clemens 2134*. On ? *Mucuna* sp., LUZON, Cagayan Province, Callao Caves, January 14, 1924, *Clemens s. n.*

74. UROMYCES ORIENTALIS Syd.

On *Indigofera trifoliata* L., LUZON, Tarlac Province, Tarlac, November, 1923, *Clemens 4889*.

75. MARAVALIA ACHROA (Syd.) comb. nov. Plate 2, fig. 5.

Uromyces achrous SYD., Ann. Myc. 5 (1907) 491.

On ? *Dalbergia* sp., LUZON, Rizal Province, Bosoboso, February 11, 1924, *Clemens 1701*.

This interesting rust is undoubtedly a representative of the genus *Maravalia* and although we have not seen Sydow's species of *Uromyces* yet we feel certain that it is the same. Only a few urediospores, measuring 11 to 15 μ in diameter, were seen. The telia are amphigenous and, on the petioles, pulvinate and nearly colorless. The teliospores are 11 to 15 by 22 to 29 μ, delicate, and have a thin, hyaline, smooth wall. There apparently is no differentiated germ pore, the apex continues to grow during germination, to produce the 4-celled basidium.

76. SPHAEROPHRAGMIUM DALBERGIAE Diet.

On *Dalbergia polyphylla* Benth., LUZON, Pangasinan Province, Rosales and vicinity, February 1 to 14, 1925, *Clemens 5905*.

This collection is assigned to the above species with some question. No uredia are present but paraphyses are present in the telia and some few show the septation which characterizes the uredial paraphyses of *S. dalbergiae*. We have not had telial material available for comparison. The teliospores in this collection are 4-celled and closely sculptured with spines which are simple or have a stellate base. The apex of the spines is not forked. The species seems to be closely related, morphologically, to *S. debile* Syd.

77. SPHAEROPHRAGMIUM LUZONICUM Yates.

On *Albizzia saponaria* Blume, LUZON, Cagayan Province, Tuguegarao, December 29, 1923, *Clemens 1738*.

This collection was identified by comparison with another of Mrs. Clemens's collections (*5907*) published by Sydow.[2] While we have not had Yates's material available it should be noted that he describes the urediospores as having a single pore. The above collection, as well as *5907*, has urediospores with four pores.

78. SPHAEROPHRAGMIUM CLEMENSIAE Syd.

On *Albizzia lebbekoides* (DC.) Benth., LUZON, Bulacan Province, Angat, November, 1924, *Clemens 4853*.

In addition to this collection we also have two numbers (*5904*, *5904a*) on the same host but collected at Rosales, Pangasinan Province, Luzon, February 1 to 14, 1925, which differ in having

[2] Ann. Myc. 29 (1931) 160.

urediospores measuring 13 to 18 by 23 to 34 μ. This is perhaps the same form as mentioned by Sydow.[3]

It has not been possible with our material to decide what disposition should be made of these specimens of *Sphaerophragmium* on *Albizzia.* If *S. luzonicum* has 1-pored urediospores it is distinct from *S. Clemensiae,* otherwise it seems to us doubtful that two species are justified. The third form with larger 4-pored urediospores, mentioned above, appears at present to be distinct. However, in view of the existing confusion regarding specific limits in this group it is inadvisable to further complicate the situation. Clarification of the problem can only be attained by a comparison of type specimens.

79. **SPHAEROPHRAGMIUM IRREGULARE** sp. nov. Plate 1, fig. 5.

Urediis hypophyllis, subepidermalibus, minutis, 0.1–0.3 mm diam.; paraphysibus periphericis, brunneis, 5–7 μ diam., membrana crassa; urediosporis obovoideis vel reniformis, 19–26 x 35–55 μ, membrana 1.5–2 μ cr. vel ad apice 3–5 μ, cinnamoneo-brunneis, echinulatis, poris germ. 4, aequatorialibus. Teliis non visis; teliosporis ex cellulis 4 compositis, oblongis vel variabilis, 24–30 x 38–52 μ; membrana 1.5 μ cr., castaneo-brunnea, aculeis subhyalinis usque 6 μ longis obsitis; pedicello hyalino, sporam aequante vel breviore.

On *Strongylodon pulcher* C. B. Rob., MINDANAO, Thermal Springs, Mount Apo, May 31, 1924, *Clemens 2032.*

Aside from inhabiting another genus of hosts this species differs markedly from any previously described in this genus in the arrangement of the cells in the teliospores, the simplicity of the spines, and the large urediospores. The urediospores are characteristic of the genus in that they are radially asymetrical, being reniform or "mitten-shaped" in one plane and obovoid in the other.

The species is further interesting in that the teliospores approach more nearly those of *Hapalophragmium* in the arrangement of the cells and the simple nature of the spines than any previously known.

80. **UREDO DERRIDICOLA** sp. nov. Plate 2, fig. 6.

Urediis hypophyllis, minutis, 100–150 μ diam., brunneis; paraphysibus periphericis, compactiusculis, hyalinis, ubique tenue tunicatis; urediosporis reniformis vel obovoideis, 15–23 x 23–26 μ; membrana 1.5 μ cr., cinnamomea, echinulata, poris germ. 1, super-aequatorialibus.

[3] Op. cit. 162.

On *Derris* sp., MINDANAO, Davao Province, Todaya, Mount Apo, June 16, 1924, *Clemens 1915* (type) ; June 18, 1924, *Clemens 2033*. LUZON, Benguet Subprovince, Mount Pulog and vicinity, February 24 to 27, 1925, *Clemens 5137*.

This species differs from other rusts on *Derris* in having urediospores with only one germ pore. The pore is located on the concave side near the apex at the widest part of the spore. The spores are radially asymetrical, obovoid with the pore in face view but "mitten-shaped" with the pore in side view.

From the peculiar shape of the spores it seems probable that the species belongs to *Sphaerophragmium* or possibly *Hapalophragmium*.

81. RAVENELIA CLEMENSAE Syd. Plate 1, fig. 1.

On *Albizzia procera* (Roxb.) Benth., MINDANAO, Cotabato Province, near Saub, June 22, 1924, *Clemens 1965*. LUZON, Pangasinan Province, Rosales and vicinity, February 1 to 14, 1925, *Clemens 5906:* Abra Province, near Bangued, February 3, 1923, *Clemens s. n.* On *Albizzia saponaria* (Lour.) Bl., LUZON, Nueva Vizcaya Province, Bambang, January 23, 1924, *Clemens s. n.*

82. RAVENELIA LAEVIOIDES sp. nov. Plate 1, fig. 4.

Urediis amphigenis vel caulicolis, subepidermalibus; paraphysibus clavatis, 15–20 x 40–50 μ, membrana 3–5 μ cr., aureobrunnea; urediosporis globosis vel ellipsoideis, 15–18 x 18–20 μ; membrana 1.5 μ cr., pallide flavida, echinulata, poris germ. obscuris, 10–12, sparsis. Teliis caulicolis, 2–7 mm longis, atrobrunneis; capitulis teliosporarum leviter convexis, obscure castaneo-brunneis, levibus, 60–100 μ diam., ex sporis 3–7 in omni directione compositis, sporis singulis unicellularibus; membrana 2–2.5 μ cr., ad apicem 3–5 μ; cystidiis capitulo adpressis, eodem numero quo sporis singulis; pedicello hyalino, crasso.

On *Indigofera nigrescens* Kurz, LUZON, Benguet Subprovince, below Camp 42, February 27, 1925, *Clemens 4972*.

This species is similar to *R. laevis* D. and H., but differs in the caulicolous habit of the telia, in having 1-celled teliospores, and in the smaller size of both the urediospores and the paraphyses.

83. RAVENELIA INDIGOFERAE Tranz.

On *Indigofera zollingeriana* Miq., LUZON, Benguet Subprovince, below Camp 42, February 24 to 27, 1925, *Clemens 4973*.

84. RAVENELIA VENUSTULA Syd. Plate 1, fig. 2.

On *Acacia pennata* (L.) Willd., LUZON, Bulacan Province, Santa Maria, November, 1924, *Clemens 4854, 4854a.*

85. RAVENELIA ORNATA Syd. Plate 1, fig. 6.

On *Abrus precatorius* L., MINDANAO, Zamboanga Province, Zamboanga, May 20, 1924, *Clemens 4929.* LUZON, Pangasinan Province, Rosales and vicinity, February 1 to 14, 1925, *Clemens 5910.*

86. SPUMULA CLEMENSIAE sp. nov. Plate 1, fig. 3.

Urediis amphigenis, subepidermalibus, minutis, castaneo-brunneis; paraphysibus periphericis, clavatis, introrsum curvatis, 10–12 μ diam., membrana 3 μ cr., ad apicem 8–10 μ, castaneo-brunnea; urediosporis oblongis, 10–16 x 24–30 μ; membrana 2 μ cr., ad apicem 3–5 μ, cinnamomeo-brunnea, echinulata, poris germ. 4, aequatorialibus. Teliis amphigenis, subepidermalibus, sine paraphyses, capitulis teliosporarum ex sporis 3–5, plerumque 4, compositis; membrana 2 μ cr., ad apicem 3–4 μ, flavida vel pallide cinnamomea, levibus; cystidiis pendulis, globosis, plerumque 2, rarius 3; pedicello, hyalino, brevi.

On *Acacia philippinarum* Benth., LUZON, Cagayan Province, Tuguegarao, December 29, 1923, *Clemens 1737.*

This species is especially interesting because of the simplicity of the teliospore heads. These heads are usually composed of four cells with only two cysts borne on a simple pedicel. None were seen in which the number of cysts equaled the number of spores. *Spumula quadrifida* Mains is the only other species in the genus.

87. PHAKOPSORA CROTALARIAE (Diet.) Arth.

On *Crotalaria albida* Heyne, LUZON, Pangasinan Province, Lingayen, November 23, 1923, *Clemens 1860.*

88. PHAKOPSORA PACHYRHIZI Syd.

On *Pachyrrhizus erosus* (L.) Urban, Luzon, Manila, Cementerio del Norte, September 18, 1923, *Clemens s. n.*

89. PHAKOPSORA MEIBOMIAE Arth.

On *Desmodium dasylobum* Miq., MINDANAO, Davao Province, Todaya, Mount Apo, June 12, 1924, *Clemens 1974.* On *Desmodium laxiflorum* DC., LUZON, Nueva Vizcaya Province, Bambang, January 21, 1924, *Clemens 1707.*

There appears to be little justification for considering that *Uredo desmodii-pulchelli* Syd. is distinct from this species.

90. PHAKOPSORA VIGNAE (Bres.) Arth.

On *Pueraria pulcherrima* Merr., MINDANAO, Davao Province, Todaya, Mount Apo, May, 1924, *Clemens 2022.*

91. UREDO DUNBARIAE sp. nov.

Urediis hypophyllis, minutis, subepidermalibus; paraphysibus periphericis, hyphoideis, hyalinis, ubique tenue tunicatis; urediosporis ellipsoideis, 18–23 x 25–31 μ; membrana 1.5 μ cr., echinulata, pallide flavida, poris germ. obscuris (3, aequatorialibus?).

On *Dunbaria ? rotundifolia* (Lour.) Merr., LUZON, Cagayan Province, near Aparri, January 9, 1924, *Clemens 1833.*

92. UREDO SUBNIGRA sp. nov. Plate 2, fig. 4.

Urediis hypophyllis, subepidermalibus, singulis in maculis atrobrunneis; paraphysibus periphericis, copiosissimis, hyphoideis, 4–9 μ diam., hyalinis, ubique tenue tunicatis; urediosporis ellipsoideis, 16–20 x 26–32 μ; membrana 1.5–2 μ cr., echinulata, flavida, poris germ. obscuris (4, aequatorialibus?).

On *Bauhinia Cumingiana* (Benth.) F. Vill., MINDANAO, Zamboanga Province, Zamboanga, May 20, 1924, *Clemens 4928.*

The sori are deep-seated with abundant, thin-walled paraphyses directed towards a central porelike orifice. We have found no other rust on *Bauhinia* with such paraphyses.

93. UREDO TERAMNIICOLA sp. nov.

Urediis hypophyllis, subepidermalibus; paraphysibus periphericis paucis praeditis, hyalinis, ubique tenue tunicatis; urediosporis ellipsoideis, 18–22 x 26–32 μ; membrana 1.5 μ cr., minute echinulata, pallide flavida; poris germ. obscuris (aequatorialibus?)

On *Teramnus labialis* (L.f.) Spreng., LUZON, Tarlac Province, Gerona, January, 1925, *Clemens 4952:* Benguet Subprovince, Adouay, February 24, 1925, *Clemens 4991.*

This species differs from *U. teramni* Mayor in having paraphyses and larger spores.

94. UREDO SOCOTRAE Syd.

On *Cassia occidentalis* L., LUZON, Cagayan Province, Tuguegarao, December 29, 1923, *Clemens 1749.*

ON SIMARUBACEÆ

95. KUEHNEOLA HARRISONIAE (Syd.) comb. nov. Plate 3, fig. 2.

Uredo harrisoniae SYD., Ann. Myc. 26 (1928) 428.

On *Harrisonia perforata* (Blco.) Merr., LUZON, Tarlac Province, Tarlac, December, 1924, *Clemens 4891:* Pangasinan Province, Rosales and vicinity, February 1 to 14, 1925, *Clemens 5911.*

Telia hypophyllous, small; teliospores produced in chains of five to ten cells, the individual spores cuboidal, 10 to 15 μ; wall colorless, 1 to 1.5 μ thick, smooth.

The characteristically irregular or lobed urediospores have been pointed out by Sydow [4] as distinctive of the species.

Confusion exists relative to the species which should be included in *Kuehneola.* Dietel [5] has included only those species which inhabit the rosaceous genera *Rubus* and *Rosa* and has placed other similar species in *Cerotelium.*[6] Although judgment can be only tentative until a thorough study has been made of the two genera, it seems to the writers that Dietel's treatment obscures relationships.

In typical species of *Cerotelium* the urediospores are unpigmented or nearly so and have ill-defined, scattered pores. The urediospores of *Kuehneola,* on the other hand, are pigmented and have a few equatorial pores. A more complete knowledge of life cycles will be necessary to a solution of the problem.

ON GUTTIFERÆ

96. UREDO CRATOXYLONIS sp. nov.

Urediis subepidermalibus, hypophyllis, minutis, brunneis; urediosporis globoideis vel ellipsoideis, 16–20 x 20–26 μ; membrana 1.5 μ cr., ad apicem 2–3 μ cr., cinnamomeo-brunnea, echinulata, poris germ. 4, aequatorialibus.

On *Cratoxylon cochinchinense* (Lour.) Bl., LUZON, Cagayan Province, near Aparri, January 9, 1924, *Clemens s. n.*

ON BURSERACEÆ

97. SKIERKA CANARII Racib.

On *Canarium luzonicum* A. Gray, LUZON, Nueva Vizcaya Province, Bambang, January, 1924, *Clemens 1720.* On *Canarium villosum?,* LUZON, Pangasinan Province, Rosales and vicinity, February 1 to 14, 1925, *Clemens 5912.*

ON EUPHORBIACEÆ

98. CROSSOPSORA SAWADAE (Syd.) comb. nov. Plate 4, fig. 1.

Cronartium sawadae SYD., Ann. Myc. 12 (1914) 109.

On *Glochidion Merrillii* C. B. Rob., LUZON, Benguet Subprovince, Mount Santo Tomas, February, 1925, *Clemens 5821.* On

[4] Loc. cit.

[5] Engler and Prantl, Nat. Pfl. 6 (1928) 60.

[6] Op. cit. 56.

Glochidion sp., LUZON, Zambales Province, Olongapo, March, 1924, *Clemens 1730.*

Pycnia and aecia are present on both collections and telia also on *1730.* The telia may arise alone or from old aecial infections. A description of the pycnia and aecia follows.

Pycnia epiphyllous, subcuticular, crustlike. Aecia mainly hypophyllous, on hypertrophied spots 3 to 10 mm in diameter, located deep within the tissue of the host, without peridium, opening irregularly; aeciospores ellipsoid or oval, often narrowed above, 15 to 21 by 24 to 30 μ; wall 1.5 μ thick or slightly thicker above, colorless, echinulate, pores obscure but seemingly equatorial.

We transfer this species to *Crossopsora* in the belief that its relationship is with that genus rather than with *Cronartium.* Aecia have not previously been reported for the genus and this species is unique in lacking uredia. The echinulate aeciospores are distinctive and decidedly different from the known aeciospores of *Cronartium.*

99. CROSSOPSORA ANTIDESMAE-DIOICAE (Rac.) comb. nov.

Uredo antidesmae-dioicae RAC., Paras. Algen und Pilze Javas 2 (1900) 33.

Cronartium antidesmae-dioicae SYD., Ann. Myc. 14 (1916) 259.

On *Antidesma ghesaembella* Gaertn., LUZON, June 1923, *Clemens s. n.:* Pangasinan Province, Rosales and vicinity, February 1 to 14, 1925, *Clemens 5916a.*

The peripheral paraphyses present in the uredia in this species are typical of those found in other species of the genus. The urediospores are also pigmented and the pores indistinct but apparently equatorial.

100. PHAKOPSORA PHYLLANTHI Diet.

On *Phyllanthus benguetensis* C. B. Rob., LUZON, Benguet Subprovince, Baguio, February, 1925, *Clemens 5823.* On *Phyllanthus niruri* L., LUZON, Cagayan Province, Solana, January 2, 1924, *Clemens 1746:* Bulacan Province, Santa Maria, November, 1924, *Clemens 4868.*

101. BUBAKIA BRIDELIAE (Koord.) Diet.

On *Bridelia glabrifolia* (Muell.-Arg.) Merr., LUZON, Pangasinan Province, Rosales and vicinity, February 1 to 14, 1925, *Clemens 5915, 5915a.*

102. BUBAKIA GLOCHIDII (Syd.) Diet.

On *Glochidion psidioides* C. B. Rob., LUZON, Nueva Vizcaya Province, Bambang, January 21, 1924, *Clemens 1711.* On *Glo-*

chidion sp., LUZON, Cagayan Province, near Callao Caves, December 31, 1923, *Clemens 1745*.

103. RAVENELIA BREYNIAE Syd.

On *Breynia rhamnoides* (Retz.) Muell.-Arg., LUZON, Rizal Province, Bosoboso, February 11, 1924, *Clemens 1701a:* Bulacan Province, Santa Maria, November, 1924, *Clemens 4862:* Tarlac Province, Gerona, January, 1925, *Clemens 4953*.

104. MASSEEELLA FLUEGGEAE Syd. Plate 4, figs. 2 and 3.

On *Flüggea virosa* (Roxb.) Baill., LUZON, Benguet Subprovince, Adouay, February 24, 1925, *Clemens 4992, 5027*.

As published by Sydow[7] the teliospores of this species are smooth. Careful study, however, proves that they are finely and longitudinally striate (see Plate 4, fig. 2).

105. ENDOPHYLLUM EMASCULATUM sp. nov.

Pycniis nullis. Teliis aecidioideis, hypophyllis, gregariis, maculis orbicularibus usque 4 mm diam. insidentia; cellulis peridii laxi conjunctis, oblongis vel cuboideis, 12–15 x 15–20 μ, pariete exteriore 3–5 μ cr., leve, interiore 2 μ cr., verrucoso; teliosporis unicellularis, globosis, 13–15 x 15–18 μ; episporio 1.5 μ cr., hyalino, minute verruculoso sed apparenter levibus.

On *Breynia rhamnoides* (Retz.) Muell.-Arg., MINDANAO, Zamboanga, May 20, 1924, *Clemens 4916*.

The absence of pycnia and the smooth or perhaps minutely verrucose spores characterize this species, which seems closely related to *Aecidium alchorneae* Sacc. We have not seen germinating spores and therefore the assignment of the species to *Endophyllum* can be only tentative.

ON ANACARDIACEÆ

106. CEROTELIUM ALIENNUM (Syd. and Butl.) Arth.

On *Spondias pinnata* (L.) Kurz., LUZON, Cagayan Province, Solana, January 2, 1924, *Clemens s. n.*

ON CORIARIACEÆ

107. PUCCINIASTRUM CORIARIAE Diet.

On *Coriaria intermedia* Mats., LUZON, Benguet Subprovince, Baguio, Mount Santo Tomas, February 19, 1925, *Clemens 4968;* Mount Pulog, below Camp 42, February 24, 1925, *Clemens 5031*.

[7] Ann. Myc. 26 (1928) 424.

ON CELASTRACEÆ

108. **UREDO CELASTRI** sp. nov.

Urediis hypophyllis vel rarius amphigenis, subepidermalibus, brunneis; urediosporis obovoideis vel ellipsoideis, 22–27 x 28–34 μ; membrana 1.5–2.5 μ cr., cinnamomeo-brunnea, valde echinulata; poris germ. 5–7, sparsis.

On *Celastrus paniculatus* Willd., LUZON, Nueva Vizcaya Province, Bambang, January 21 to 23, 1924, *Clemens 1693.*

ON HIPPOCRATACEÆ

109. **CAEOMA DIVINUM** Syd.

On *Salacia philippinensis* Merr., LUZON, Tarlac Province, La Paz, December, 1924, *Clemens 4894.* On *Salacia prinoides* DC., LUZON, Zambales Province, Iba, February 27, 1924, *Clemens 1723.*

ON BALSAMINACEÆ

110. **PUCCINIA ARGENTATA** (Schultz) Wint.

On *Impatiens Barnesii* Hk. f., LUZON, Benguet Subprovince, Camps 30 to 42, February, 1925, *Clemens 5141.* On *Impatiens Burkei* Hk. f., MINDANAO, Todaya, Mount Apo, May 27, 1924, *Clemens 1981.*

ON SABIACEÆ

111. **PHAKOPSORA MELIOSMAE** Kusano.

On *Meliosma multiflora* Merr., LUZON, Benguet Subprovince, Mount Pulog, February 1925, *Clemens s. n.*

ON RHAMNACEÆ

112. **PUCCINIA GOUANIAE-TILIAEFOLIAE** Syd.

On *Gouania tiliaefolia* Lam., LUZON, Bulacan Province, Santa Maria, November, 1924, *Clemens 4857.*

ON VITACEÆ

113. **PHYSOPELLA VITIS** (Thüm.) Arth.

On *Cissus simplex* Blco., LUZON, Pangasinan Province, Mount Bulangao, Rosales and vicinity, February 1 to 14, 1925, *Clemens 5917.*

114. **PHAKOPSORA AMPELOPSIDIS** Diet. and Syd.

On *Ampelopsis heterophylla* (Thun.) Zieb. and Zucc., LUZON, Nueva Vizcaya Province, Bambang, January 21, 1924, *Clemens s. n.*

ON MALVACEÆ

115. **CEROTELIUM DESMIUM** (B. and Br.) Arth.

On *Gossypium ? brasiliensis,* MINDANAO, Davao Province, Todaya, Mount Apo, May, 1924, *Clemens 5648.*

ON TILIACEÆ

116. RAVENELIA ATRIDIS Syd.

On *Grewia eriocarpa* Juss., LUZON, Nueva Vizcaya Province, Bambang, January 21, 1924, *Clemens s. n.* On *Grewia multiflora* Juss., LUZON, Cagayan Province, Solana, January 2, 1924, *Clemens 4415.*

117. UREDO COLUMBIAE sp. nov. Plate 3, fig. 5.

Urediis hypophyllis, subepidermalibus; paraphysibus periphericis, 5–8 μ diam., ad apicem attenuatis, membrana 1 μ cr., hyalina; urediosporis ellipsoideis, 16–20 x 22–29 μ; membrana 1–1.5 μ cr., pallide flavida vel hyalina, minute echinulata, poris germ. obscuris.

On *Columbia serratifolia* (Cav.) DC., LUZON, Tarlac Province, La Paz, December 10, 1924, *Clemens 4892.*

The sori in this species are rather deep-seated and in gross appearance are much like those of *Uredo lueheae* Speg., but differ in having pointed paraphyses and smaller spores.

ON ERICACEÆ

118. CHRYSOMYXA DIETELII Syd.

On *Rhododendron subsessile* Rendle, LUZON, Benguet Subprovince, Mount Santo Tomas, February 19, 1925, *Clemens 4966, 4968;* Mount Pulog, February 25, 1925, *Clemens 5022.*

ON OLEACEÆ

119. UROMYCES HOBSONI Vize.

On *Jasminum aculeatum* (Blco.) Walp., LUZON, Benguet Subprovince, Adouay, February 24 to 27, 1925, *Clemens 4997, 5023a.* On *Jasminum populifolium* Blume, LUZON, Benguet Subprovince, Adouay, February 27, 1925, *Clemens 5023.*

ON THYMELEACEÆ

120. MELAMPSORA YOSHINAGAI P. Henn.

On *Wikstroemia ovata* Mey., MINDANAO, Todaya, Mount Apo, June 18, 1924, *Clemens 2065:* LUZON, Tarlac Province, Tarlac, December, 1924, *Clemens 4897.* (See also *Phaleria* under 121, next following.)

ON APOCYNACEÆ

121. ACROTELIUM ICHNOCARPI Syd. Plate 3, fig. 1.

On *Ichnocarpus ovalifolius* A. DC., LUZON, Cagayan Province, Solana, January 2, 1924, *Clemens 1828;* Tarlac Province, Paniqui, January, 1925, *Clemens 4963.* MINDANAO, Davao Province, Mount Apo, Todaya, June 18, 1924, *Clemens 2058;* May 26,

1924, *Clemens 2059*. On *Phaleria* sp. (Thymeleaceæ) LUZON, Benguet Subprovince, Mount Pulog and vicinity, February 24 to 27, 1925, *Clemens 5020*. On *Trachelospermum Vanoverberghii* Merr., LUZON, Nueva Vizcaya Province, Bambang, January 23, 1924, *Clemens 1708*. On ? *Gymnema* sp. (Asclepiadaceæ), LUZON, Isabela Province, Echague, December 20, 1923, *Clemens 1733*.

The hosts are listed here as they appear on the labels, but it is not improbable that all are *Ichnocarpus*. There is no cause for questioning the identity of the rust, whether or not the hosts are all of a single genus.

Superficially the telia of this genus are strikingly like those of *Maravalia*, but the manner of germination by an internal basidium distinguishes the genus sharply from *Maravalia*. Except for the absence of a gelatinous matrix the telia also resemble somewhat those of the genus *Goplana*, which likewise develops an internal basidium. Urediospores may occur in individual sori or intermingled with the teliospores.

The genus is interesting but certainly has no relationship with *Coleosporium*, although Sydow [8] named it as a genus of the Coleosporiaceæ. The development of an internal basidium has evidently occurred at several widely separated places in the order Uredinales and can no longer be given major importance as a family characteristic.

122. CROSSOPSORA AGANOSMAE Syd.

On *Aganosma velutina* A. DC., LUZON, Nueva Vizcaya Province, Bambang, January 21, 1924, *Clemens s. n.*

123. HEMILEIA WRIGHTIAE Rac.

On *Wrightia laniti* (Blco.) Merr., MINDANAO, Zamboanga, May 20, 1924, *Clemens 4917;* LUZON, Pangasinan Province, Rosales and vicinity, February 1 to 14, 1925, *Clemens 5920*.

124. PUCCINIA ENGLERIANA P. Henn.

On *Tabernaemontana pandacaqui* Poir., LUZON, Tarlac Province, Tarlac, December, 1924, *Clemens 4898;* Paniqui, January 1925, *Clemens 4962;* Gerona, January, 1925, *Clemens 4962a*. On *Tabernaemontana* sp., LUZON, Pangasinan Province, Mount Balungao, Rosales and vicinity, February 1 to 14, 1925, *Clemens 5918*.

Aecia are present in *4898* and *4962* and probably represent the aecial stage of this species. A description follows.

[8] Ann. Myc. 26 (1928) 425.

Pycnia not seen, perhaps not formed. Aecia amphigenous and caulicolous, causing extensive hypertrophy and distortion, deep-seated, large, orange-yellow when fresh, with no peridium but with a dense layer of hyphæ and collapsed host-tissue; aeciospores globoid, ellipsoid or oblong, 21 to 27 by 28 to 40 μ; wall 3 to 5 μ thick, hyaline or pale yellowish, closely and coarsely verrucose.

125. **AECIDIUM LAGUNENSE** Syd.

On *Tabernaemontana* sp., LUZON, Nueva Vizcaya Province, Bambang, January 23, 1924, *Clemens s. n.*

This collection is fragmentary, but the rust is apparently this species, judging from the apical thickening of the walls of the aeciospores.

ON GENTIANACEÆ

126. **COLEOSPORIUM EXACI** Syd.

On *Exacum chironioides* Griseb., LUZON, Cagayan Province, Tuguegarao, January 14, 1924, *Clemens s. n.*

ON CONVOLVULACEÆ

127. **AECIDIUM KAERNBACHII** P. Henn.

On *Ipomoea* sp., MINDANAO, Davao Province, Daron, June 21, 1924, *Clemens 2061.* On *Lepistemon obscurum* (Blco.) Merr., LUZON, Cagayan Province, Tuguegarao, December 29, 1923, *Clemens 1820.* On *Merremia umbellata* Hall. f., MINDANAO, Davao Province, Daron, May, 1924, *Clemens 4931.* On *Merremia* sp. (or *Ipomoea* sp.), LUZON, Manila, September, 1923, *Clemens s. n.*

ON VERBENACEÆ

128. **PUCCINIA EREBIA** Syd.

On *Clerodendron minahassae* T. and B., LUZON, Manila, near San Francisco Church, October 9, 1923, *Clemens 1603.*

129. **PUCCINIASTRUM CLEMENSIAE** sp. nov. Plate 3, fig. 6.

Urediis hypophyllis, minutis; cellulis peridii cuboideis, membrana 3 μ cr., hyalina; urediosporis ellipsoideis, 13–16 x 18–21 μ; membrana 1–1.5 μ cr., hyalina, minute echinulata, poris germ. obscuris. Teliis ignotis.

On *Vitex negundo* L., LUZON, Pangasinan Province, Rosales and vicinity, February 1 to 14, 1925, *Clemens 5924* (type), *5925;* Nueva Vizcaya Province, Bambang, January 21, 1924, *Clemens 1709.*

This species is dedicated to Mrs. Mary Strong Clemens, a discriminating collector, whose name cannot be too often associated with the Uredinales of the Philippine Islands.

130. CROSSOPSORA PREMNAE (Petch) Syd.

On *Premna nauseosa* Blco., LUZON, Manila, Cementerio del Norte, October 9, 1923, *Clemens 1604*. On *Premna* sp., LUZON, Isabela Province, Tumauini, December 25, 1923, *Clemens 1830:* Cagayan Province, Callao Caves, January 14, 1924, *Clemens s. n.*

131. UREDO CALLICARPAE Petch.

On *Callicarpa formosana* Rolfe, LUZON, Isabela to Nueva Vizcaya Province, Iligan, January 18 to 19, 1923?, *Clemens s. n.:* Tarlac Province, Gerona, January, 1925, *Clemens 4955, 4955a.* On *Callicarpa* sp., LUZON, Benguet Subprovince, below Camp 42, February 24, 1925, *Clemens 5029.*

This interesting species probably belongs in the genus *Crossopsora* near *C. premnae* which also has similar urediospores and septate paraphyses differing only in minor details.

ON LABIATEÆ

132. COLEOSPORIUM PLECTRANTHI Barcl.

On *Plectranthus diffusus* Merr., LUZON, Benguet Subprovince, Mount Pulog, February 24, 1925, *Clemens 5142;* Mount Santo Tomas, February 19, 1925, *Clemens 5829;* Baguio, February, 1925, *Clemens 5829a.*

133. PUCCINIA PLECTRANTHELLA sp. nov. Plate 3, fig. 7.

Pycniis ignotis. Aeciis et urediis nullis. Teliis hypophyllis, in maculis deformantibus profunde immersis; teliosporis oblongis vel clavatis, 14–17 x 33–50 μ; membrana 1.5 μ cr., ad apicem 2–3 μ, hyalina vel pallide flavida, levibus, statim germinantes, pedicello hyalino, brevi, fragili.

On *Plectranthus* or *Coleus* sp., MINDANAO, Thermal Springs, Mount Apo, May 31, 1924, *Clemens 2030.*

This species is similar to *P. plectranthi* Thüm, but differs in being microcyclic and having teliospores with a much thinner apical wall and an almost total absence of color. The telia occur on small hypertrophied spots and are sunken in small pockets of the host tissue.

134. PUCCINIA HYPTIDIS (M. A. Curt.) Tr. and Earle.

On *Hyptis spicigera* Lam., MINDANAO, Davao Province, Daron, May, 1924, *Clemens 4932.*

135. PUCCINIA DILECTA Syd.

On *Gomphostema philippinarum* Benth., MINDANAO, Mount Apo, Thermal Springs, May 31, 1924, *Clemens 2028.*

ON ACANTHACEÆ

136. PUCCINIA RUELLIAE (B. and Br.) Lagerh.

On *Ruellia repens* L., LUZON, Pangasinan Province, Rosales and vicinity, February 1 to 14, 1925, *Clemens 5927a.*

137. PUCCINIA THWAITESII B. and Br.

On *Justicia gendarussa* Burm. f., MINDANAO, Zamboanga, May 20, 1924, *Clemens 4939.*

138. PUCCINIA HEMIGRAPHIDIS sp. nov. Plate 3, fig. 4.

Pycniis ignotis. Aeciis et urediis nullis. Teliis hypophyllis, subepidermalibus, minutis, in macula 2–8 mm diam. insidentibus; teliosporis oblongis, medio constrictis, 18–23 x 32–50 μ; membrana 2 μ cr., ad apicem 3–5 μ, pallide castaneo-brunnea, levibus, statim germinantes; pedicello hyalino, persistenti, sporam aequante.

On *Hemigraphis* sp., MINDANAO, Mount Apo, below Todaya, May 26, 1924, *Clemens 1978.*

139. UREDO HYGROPHILAE Syd.

On *Hygrophila phlomoides* Nees, LUZON, Manila, Cementerio del Norte, February 14, 1924, *Clemens 1704.*

140. AECIDIUM THUNBERGIAE-FRAGRANTIS Syd.

On *Thunbergia fragrans* Roxb., MINDANAO, Zamboanga Province, Zamboanga, May 20, 1924, *Clemens 4918.*

141. AECIDIUM MANILENSE sp. nov.

Pycniis hypophyllis, subepidermalibus. Aeciis hypophyllis, per totam folii superficiem occupantibus; cellulis peridiis firme conjunctis, 15–18 x 28–35 μ, pariete interiore verrucoso, 4–6 μ cr., exteriore levi, 2–2.5 μ cr.; aeciosporis oblongis vel ellipsoideis, 18–26 x 24–31 μ; membrana 2–2.5 μ cr., hyalina, dense minuteque verruculosa.

On *Hygrophila phlomoides* Nees, LUZON, Manila, Cementerio del Norte, February 14, 1924, *Clemens 1597a.* On *Hygrophila* sp. (*phlomoides?*), LUZON, Pangasinan Province, Rosales and vicinity, February 1 to 14, 1925, *Clemens 5927* (type).

Pycnia do not seem always to accompany the aecia or the aecia completely displace them. Pycnia likewise occur on leaves where there are no aecia. Even in the normal appearing pycnia no pycniospores were seen.

ON RUBIACEÆ

142. COLEOSPORIUM KNOXIAE Syd.

On *Knoxia corymbosa* Willd., LUZON, Pangasinan Province, Lingayen, November, 1923, *Clemens 1800.*

143. HEMILEIA CANTHII B. and Br.

On *Plectronia peduncularis* (Cav.) Vid., LUZON, Pangasinan Province, Rosales and vicinity, February 1 to 14, 1925, *Clemens 5928.*

144. HEMILEIA VASTATRIX B. and Br.

On *Coffea arabica* L., MINDANAO, Zamboanga Province, Zamboanga, May 20, 1924, *Clemens 4938.*

145. PUCCINIA GEOPHILAE Racib.

On *Geophila herbacea* (Jacq.) Kuntze, MINDANAO, Davao Province, Mount Apo, Todaya, 1924, *Clemens 2063.*

146. UREDO PSYCHOTRIICOLA P. Henn.

On *Psychotria luzoniensis* (Cham. and Schlect.) F. Vill., LUZON, Cagayan Province, Aparri, January 9, 1924, *Clemens 1832.*

147. UREDO LASIANTHI Syd.

On *Lasianthus tashiroi* Mats., MINDANAO, Davao Province, below Mount Apo, Todaya, May, 1924, *Clemens 2017.*

148. AECIDIUM PAEDERIAE Diet.

On *Paederia foetida* L., LUZON, Cagayan Province, Callao Caves, December 31, 1923, *Clemens 1825:* Benguet Subprovince, Adouay, February 24, 1925, *Clemens 4996.*

149. AECIDIUM FLAVIDUM B. and Br.

On *Pavetta indica* L., MINDANAO, Davao Province, Mount Apo, below Todaya, May 26 to 27, 1924, *Clemens 1975.*

150. AECIDIUM DAPSILE sp. nov.

Pycniis ramicolis vel foliicolis, subcuticularibus, lenticularis, rufo-brunneis, sine paraphysibus. Aeciis ramicolis vel foliicolis, matricem deformantibus, densiuscule dispersis, profunde immersis; cellulis peridii laxiuscule conjunctis, 10–14 x 16–24 μ, pariete exteriore levi, 2 μ cr., interiore verrucoso, 3–4 μ cr.; aeciosporis globosis, 15–18 x 17–19 μ, membrana 1–1.5 μ cr., pallide flavida vel subhyalina, minutissime verrucoso-echinulata.

On *Plectronia Mabesae* Elm., LUZON, Bulacan Province, Angat, November 3, 1924, *Clemens 4855.*

This species has much the habit of *Aecidium prolixum* Syd. on *Wrightia* and also agrees quite closely with the description of *A. hedyotidis* Syd. on *Hedyotis,* a rubiaceous genus. The

position of the pycnia is not given for the latter species. It is interesting that both *Wrightia* and *Plectronia* also serve as hosts for species of *Hemileia,* but there is no other evidence to indicate that these aecia belong in the life cycle of those species.

ON CAMPANULACEÆ

151. **COLEOSPORIUM CAMPANULAE (Pers.) Lév.**

On *Wahlenbergia bivalvis* Merr., LUZON, Benguet Subprovince, Mount Pulog, February 25, 1925, *Clemens 4998.*

ON CUCURBITACEÆ

152. **PUCCINIA MELOTHRIICOLA Syd.**

On *Melothria mucronata* (Bl.) Cogn., LUZON, Benguet Subprovince, between Camp 30 and Baguio, February, 1925, *Clemens 5144;* Mount Santo Tomas, February 19, 1925, *Clemens 5832.*

Pycnia and uredinoid aecia are present on both specimens, in addition to uredia and telia. A description follows.

Pycnia amphigenous, subepidermal. Aecia amphigenous, subepidermal, in a small circle about the pycnia, uredinoid, cinnamon-brown; aeciospores resembling urediospores, ellipsoid or globoid, 24 to 31 by 29 to 37 μ; wall 1.5 μ thick, cinnamon-brown, sharply echinulate, pores 2, opposite and superequatorial.

ON COMPOSITÆ

153. **UROMYCES BIDENTICOLA (P. Henn.) Arth.**

On *Bidens pilosa* L., MINDANAO, Mount Apo, Todaya, May 30, 1924, *Clemens 2019.* LUZON, Benguet Subprovince, Adouay, February, 1925, *Clemens 5019, 5146;* Mount Santo Tomas, February 19, 1925, *Clemens 5839.*

154. **UROMYCES WEDELIAE P. Henn.**

On *Wedelia biflora* (L.) DC., MINDANAO, Cotabato Province, Petagos, June 22 and 23, 1924, *Clemens 1964:* Davao Province, below Todaya, June 18 to 20, 1924, *Clemens 2060.*

Only pycnia and uredinoid aecia are present on these specimens. Sydow [9] pointed out that these uredinoid aecia are the form described as *Uredo nerviseda* Syd., characterized by spores which have a single germ pore.

155. **PUCCINIA MILLEFOLII Fckl.**

On *Artemisia capillaris* Thunb., LUZON, Benguet Subprovince, below Adouay, February 24 to 27, 1925, *Clemens 4999.*

Uredo artemisiae-japonici Diet. is also present on this specimen.

[9] Ann. Myc. 15 (1917) 172.

156. PUCCINIA CIRSII Lasch.

On *Cirsium luzoniense* Merr., LUZON, Benguet Subprovince, Mount Pulog and vicinity, February 24 to 27, 1925, *Clemens 5147, 5147a;* Mount Santo Tomas, February 19, 1925, *Clemens 5835.*

157. UREDO MICROGLOSSAE Petch.

On *Microglossa volubilis* (Wall.) DC., MINDANAO, Mount Apo, Todaya, May, 1924, *Clemens 2020.*

158. UREDO VERNONIICOLA Petch.

On *Vernonia patula* (Dry.) Merr., LUZON, Cagayan Province, Solana, January 2, 1924, *Clemens s. n.:* Rizal Province, Antipolo, February 11, 1924, *Clemens 1700.*

159. UREDO ELEPHANTOPODIS Petch.

On *Elephantopus scaber* L., LUZON, Nueva Vizcaya Province, Bambang, January 19, 1924, *Clemens s. n.*

Uredo elephantopodis and *U. vernoniicola* are probably the same species, but without telia there can be no advantage in uniting them. The septate paraphyses are similar to those found in some species of *Crossopsora,* as *C. premnae,* and it is probable that the species will be found to belong in that genus.

160. UREDO ERIGERONTIS sp. nov. Plate 3, fig. 3.

Urediis amphigenis, minutis, sparsis, subepidermalibus; urediosporis obovoideis, 15–19 x 23–33 μ; membrana 1 μ cr., pallide flavida, minute echinulata, poris germ. obscuris, 4, aequatorialibus.

On *Erigeron sumatrensis* Retz., LUZON, Nueva Vizcaya Province, Santa Fe, January 25, 1924, *Clemens 1690* (type): Benguet Subprovince, Adouay, February 24 to 27, 1925, *Clemens 5001;* Mount Pulog and vicinity, February, 1925, *Clemens 5145.*

161. AECIDIUM FORMOSANUM Syd.

On *Emilia sonchifolia* (L.) DC., LUZON, Nueva Vizcaya Province, Bambang, January 23, 1924, *Clemens 1705.*

162. AECIDIUM BLUMEAE P. Henn.

On *Blumea balsamifera* (L.) DC., MINDANAO, Zamboanga Province, May 20, 1924, *Clemens 4940.* LUZON, Pangasinan Province, Rosales and vicinity, February 1 to 14, 1925, *Clemens 5929.*

163. AECIDIUM BANOSENSIS Syd.

On *Vernonia arborea* Ham., MINDANAO, Davao Province, Mount Apo, below Todaya, May 26, 1924, *Clemens 1977.* On *Vernonia*

vidalii Merr., LUZON, Nueva Vizcaya Province, Bambang, January 21 and 23, 1924, *Clemens 1695.*

164. PUCCINIA LACTUCAE Diet.

On *Lactuca dentata* (Thunb.) C. B. Rob., LUZON, Benguet Subprovince, above Adouay, February 24 to 27, 1925, *Clemens 5000;* Mount Santo Tomas, February 19, 1925, *Clemens 5837.*

INDEX

Index to species of rusts enumerated in the Philippine Journal of Science 59 (1936) 437–448; 61 (1936) 463–485. Numbers in the index are serial numbers of the species, not page numbers. New specific names are printed in boldface.

INDEX TO SPECIFIC NAMES

INDEX TO SPECIFIC NAMES—Continued

ILLUSTRATIONS

PLATE 1

FIG. 1. *Ravenelia Clemensiae* Syd., a teliospore head; × 650. (Bangued, Abra, February 3, 1923, *Clemens s. n.*)

2. *Ravenelia venustula* Syd., a teliospore head; × 650. (*Clemens 4854.*)

3. *Spumula Clemensiae* Arth. and Cumm., urediospores, one uredial paraphysis, and one of the teliospore heads; × 650. (*Clemens 1737.*)

4. *Ravenelia laevioides* Arth. and Cumm., one urediospore, one uredial paraphysis, and one teliospore head; × 650. (*Clemens 4972.*)

5. *Sphaerophragmium irregulare* Arth. and Cumm., one of the radially asymetrical urediospores and two teliospores; × 650. (*Clemens 2032.*)

6. *Ravenelia ornata* Syd., a teliospore head showing the characteristic sculpturing; × 650. (*Clemens 5910.*)

PLATE 2

FIG. 1. *Gerwasia fasciculata* Arth. and Cumm., a single telium showing the stalklike base with the contorted, incurved paraphyses surrounding the colorless teliospores; × about 900. (*Clemens 5134.*)

2. *Pucciniosira Clemensiae* Arth. and Cumm., two teliospores with intercalary cells. One cell is producing a basidium; × about 900. (*Clemens 4974.*)

3. *Crossopsora fici* Arth. and Cumm., two urediospores; × about 900. (*Clemens 1727.*)

4. *Uredo subnigra* Arth. and Cumm., one of the peripheral, thin-walled paraphyses and two urediospores; × about 900. (*Clemens 4928.*)

5. *Maravalia achroa* (Syd.) Arth. and Cumm., three teliospores showing manner in which the basidium is produced by a continued growth of the apex of the spores; × about 1,000. (*Clemens 1701.*)

6. *Uredo derridicola* Arth. and Cumm., two of the radially asymetrical, 1-pored urediospores; × about 1,000. (*Clemens 1915.*)

PLATE 3

FIG. 1. *Acrotelium ichnocarpi* Syd., teliospores showing the basal, proliferating cell and the manner in which the teliospores germinate by the formation of an internal basidium; × 650. (*Clemens 5020.*)

2. *Kuehneola Harrisoniae* (Syd.) Arth. and Cumm., a telium and two of the characteristically lobed urediospores; × 650. (*Clemens 5911.*)

FIG. 3. *Uredo erigerontis* Arth. and Cumm., one urediospore; × 650. (*Clemens 1690.*)

4. *Puccinia hemigraphidis* Arth. and Cumm., two teliospores; × 650. (*Clemens 1978.*)

5. *Uredo columbiae* Arth. and Cumm., one urediospore and one of the thin-walled, attenuate, peripheral paraphyses present in the uredia; × 650. (*Clemens 4892.*)

6. *Pucciniastrum Clemensiae* Arth. and Cumm., a section of a uredium showing the peridium and several urediospores; × 650. (*Clemens 5924.*)

7. *Puccinia plectranthella* Arth. and Cumm., two teliospores; × 650. (*Clemens 2030.*)

PLATE 4

FIG. 1. *Crossopsora Sawadae* (Syd.) Arth. and Cumm., a photograph showing the subcuticular pycnia and the deep-seated, aperidiate aecia; × about 100. (*Clemens 5821.*)

2. *Masseeella flueggeae* Syd., a photograph of the teliospores, showing the faint, longitudinal striations on the walls; × about 500. (*Clemens 4992.*)

3. *Masseeella flueggeae* Syd., a photograph of a portion of a telium, showing the unicellular, apedicellate teliospores and the surrounding gelatinous matrix; × about 100. (*Clemens 4992.*)

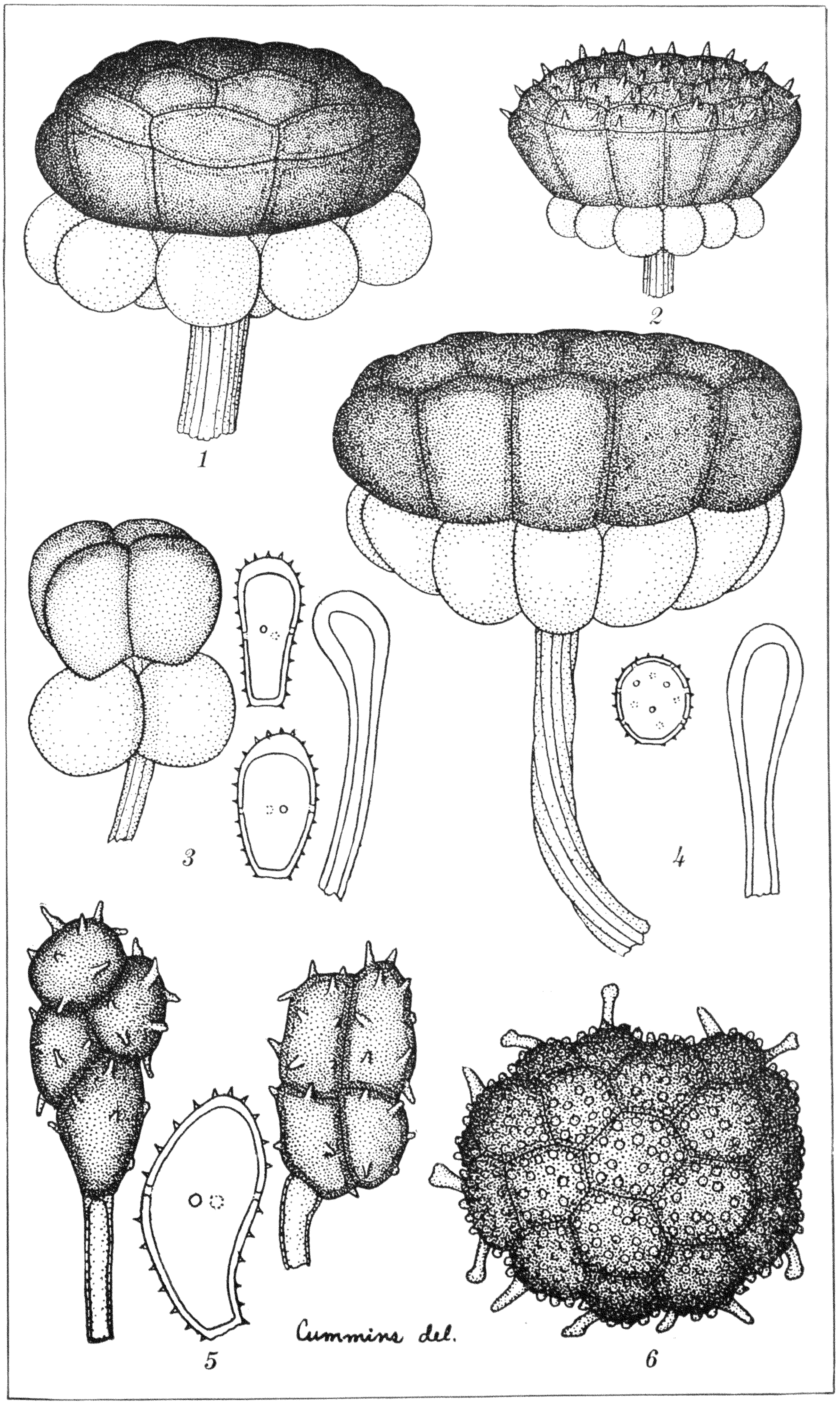


PLATE 1.

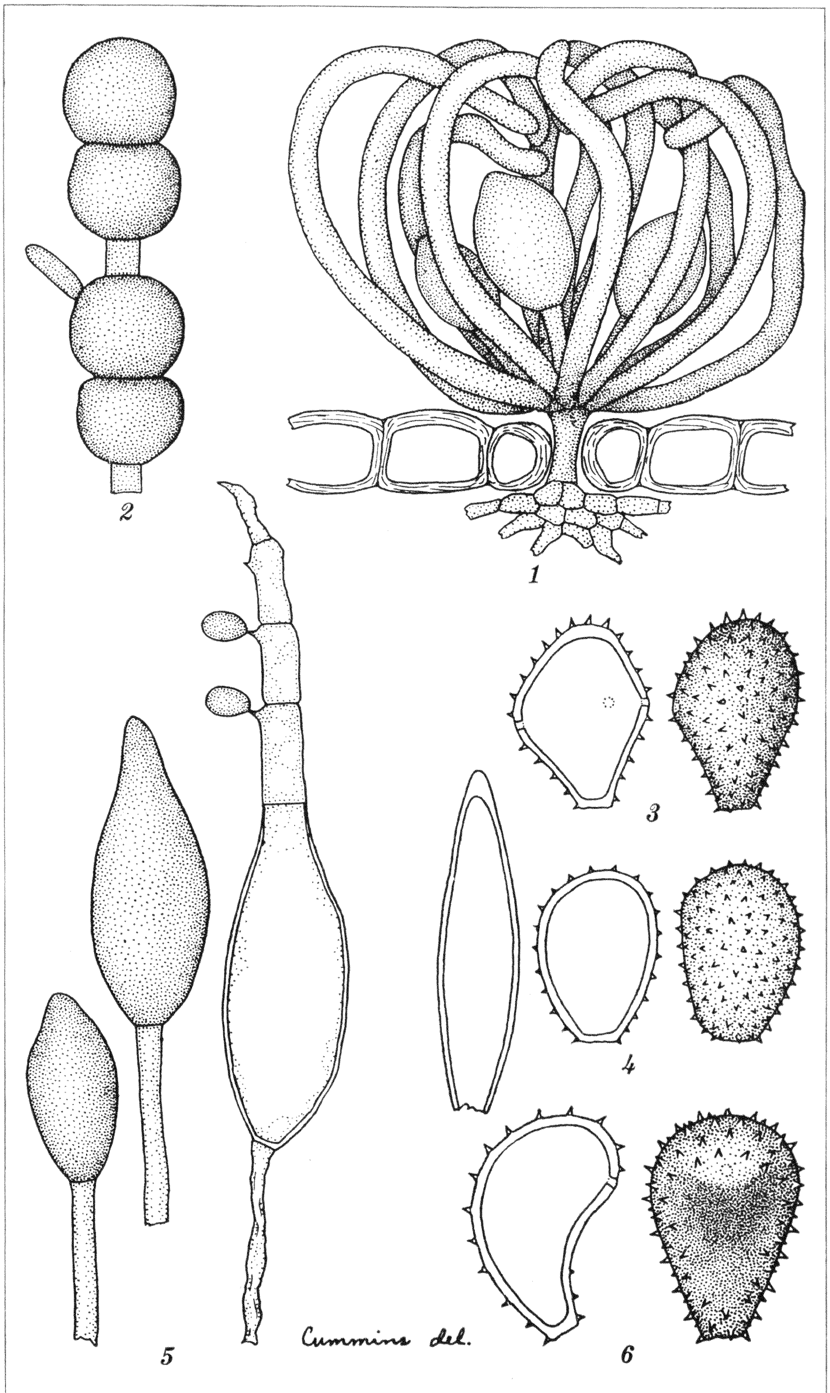


PLATE 2.

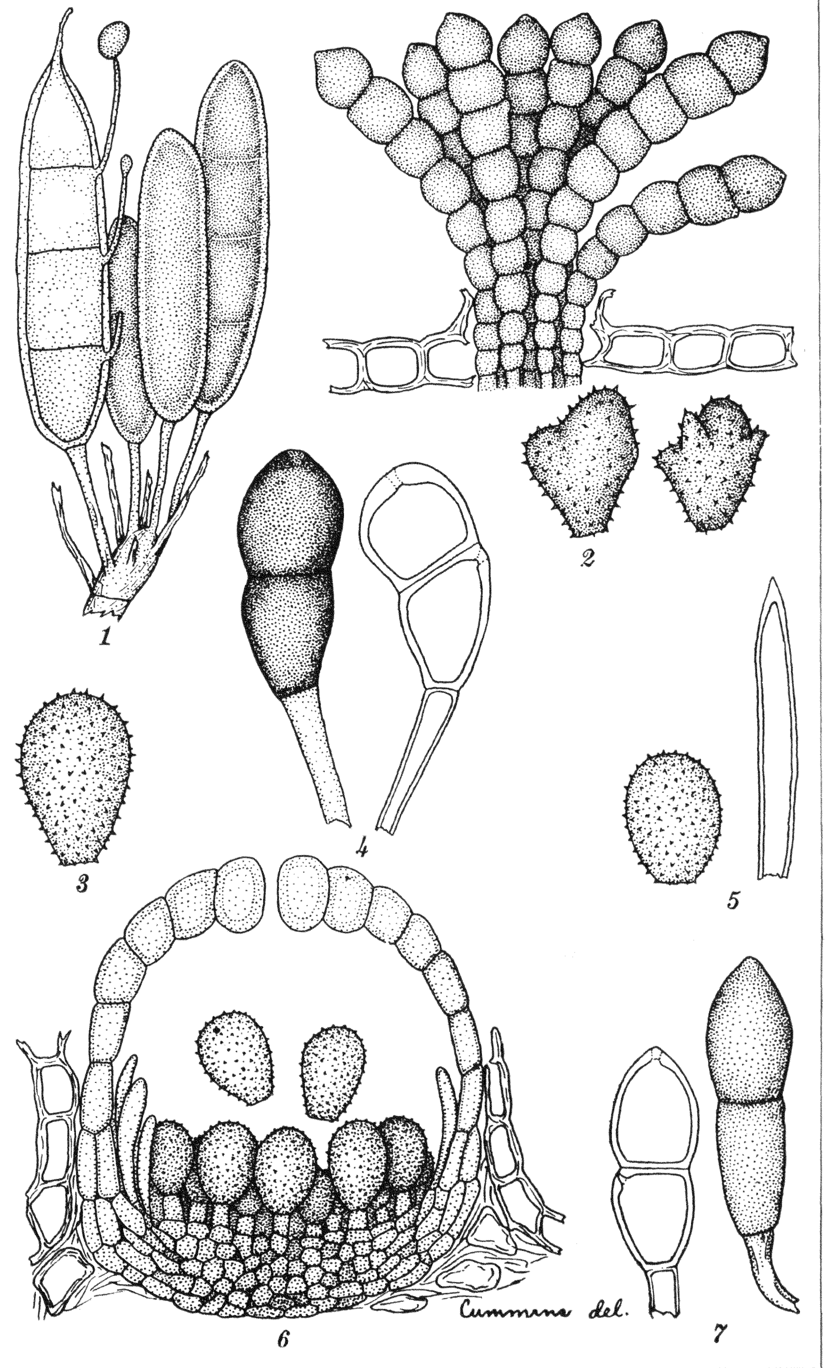


PLATE 3.

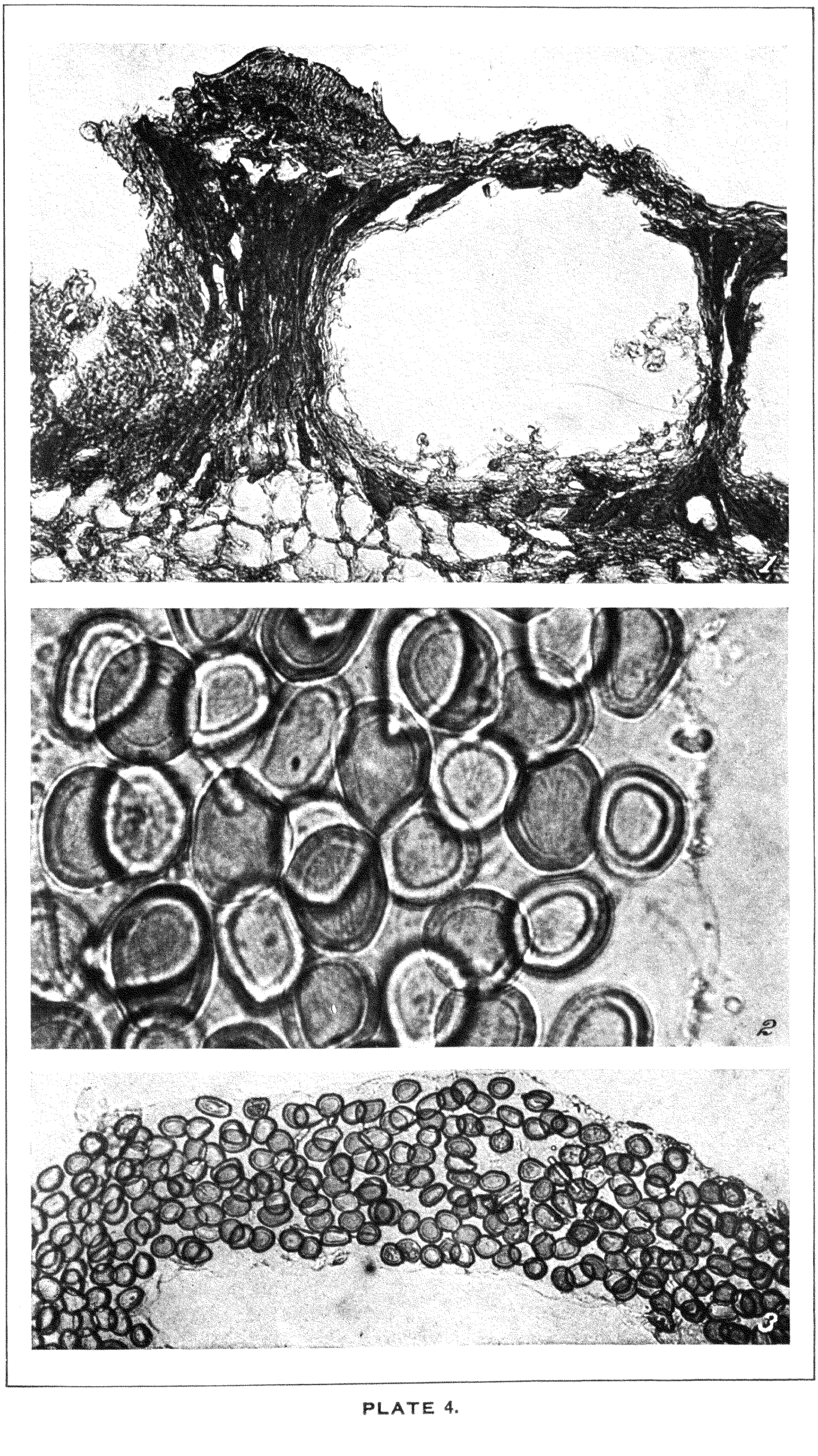


PLATE 4.

PHILIPPINE RECENT SHELLS, I

By GODOFREDO L. ALCASID

Of the National Museum Division, Bureau of Science, Manila

TWO PLATES

In the present paper all species of the family Doliidæ known or reported to occur in the Philippine Archipelago are considered.

Family DOLIIDÆ Adams

Shell thin, ventricose, ovate or subglobular, spire short, body whorl large, transversely ribbed or decussated; devoid of operculum in the adult.

Key to Philippine Doliidæ.

a^1. Shell globosely swollen, ventricose, transversely ribbed .... *Dolium*.
  b^1. Shell thin, lip simple or very slightly thickened.
    c^1. Interstices between ribs narrow and shallow.
      d^1. Shell fulvous-brown with whitish lunate spots .... *perdix*.
      d^2. Shell fulvous-chestnut, maculated with white .... *olearia*.
      d^3. Shell with spiral, longitudinally lineated bands .... *cumingii*.
      d^4. Shell with bands of white and brown spots .... *deshayesii*.
    c^2. Interstices between ribs wide.
      e^1. Shell provided with small ribs between the large principal ribs. *zonatum*.
      e^2. Shell 5 banded with chestnut .... *sulcosum*.
      e^3. Shell with pale brown ribs .... *allium*.
      e^4. Shell with brown spots on the ribs .... *fimbriatum*.
  b^2. Shell solid, lip thickened, somewhat reflected .... *poma*.
a^2. Shell elongately pyriform, ventricose, canaliculated at the base. *Pyrula*.
      f^1. Shell reticulately cancellated throughout .... *reticulata*.
      f^2. Shell elongated, slender, transversely ridged, cancellated. *dussumieri*.
      f^3. Shell short, surface rather smooth .... *ficus*.

Genus DOLIUM Brown

Shell thin, globular, ventricose, spire short, body whorl very large, transversely ribbed, aperture large, lip simple or slightly crenulated, columella rather twisted, umbilicated.

Dolium Lamarck 1801 [1] had long been in use and generally accepted when it was found necessary to use *Tonna* Brunnich

[1] Lamarck, Anim. sans Vert. (1801) 79.

1772 [2] for priority. On further investigation it has been noted that *Dolium* Brown 1756 [3] has more claim and therefore it is being used here. Tryon used *Dolium* Linnæus,[4] and as synonyms gave *Perdix* Montfort and *Doliopsis* Conrad, but in his Manual [5] he used *Dolium* Lamarck.

DOLIUM PERDIX (Linnæus). Plate 1, fig. 1.

Buccinum perdix LINNÆUS, Syst. Nat. ed. 12 1 [2] (1767) 1197; DILLWYN, Cat. Recent Shells 2 (1817) 583.

Dolium perdix Linnæus, LAMARCK, Anim. sans Vert. 7 (1822) 261; KIENER, Icon. Coq. Viv. *Dolium* p. 4, pl. 5, fig. 9; REEVE, Conchol. Icon. 5 (1849) *Dolium* pl. 6, fig. 9; HANLEY, Proc. Zool. Soc. (1859) 492; TRYON, Man. Conchol. 7 (1885) 264, pl. 3, fig. 15; pl. 4, figs. 23–25; HIDALGO, Cat. Marine Moll. (1904) 153.

Tonna perdix Linnæus, HEDLEY, Rec. Aust. Mus. 12 (1919) 335; FAUSTINO, Bur. Sci. Monog. 25 (1928) 226.

Shell oblong-ovate, thin, spire exserted; base somewhat obliquely effused, umbilicated; whorls six, transversely ribbed, ribs about twenty, broad, smooth, rather flattened; grooves between ribs narrow and shallow; fulvous-brown marked with whitish lunate spots; interior of aperture brownish, washed with white towards the outer lip; lip simple; columella arched.

Height, 144 mm; thickness, 76; height of spire, 37; height of body whorl, 92.

Philippines, *Bur. Sci. 13205 Fulton.* BOHOL, *Bur. Sci. 14164 Kelly.* CEBU, *Bur. Sci. 14219 Lopez.* MINDORO, Calapan, *Bur. Sci. 12938 Labsan.* MARINDUQUE, *Hidalgo.* MINDANAO, Dapitan and Zamboanga, *Hidalgo.* JOLO, *Hidalgo.*

Distribution.—Coasts of America, *Linnæus;* Jamaica, *Lister;* Amboina, *Rumphius;* coast of Senegal, *Adanson;* West Indies, China, and South Seas, *Humphreys;* Indian, African, and American equatorial seas, *Lamarck;* Indian Ocean, Mauritius, Polynesia, West Africa, West Indies, and Brazil, *Tryon.*

The spire of this species is rather exserted, making the general form more elongate as compared with other members of this genus. The lip is simple with a slight thickening of white nacreous deposit, which gradually diminishes towards the interior. The lunate spots which characterize this species are not well marked in young specimens, the painting being diffused rectangular and linear spots.

[2] Morch, Malak. Blatt. 18 (1871) 16; Hedley, Rec. Aust. Mus. 12 (1919) 329; Faustino, Bur. Sci. Monog. 25 (1928) 225.

[3] Sowerby, Conchol. Man. (1852) 146.

[4] Tryon, Struct. Syst. Conchol. 2 (1883) 202.

[5] Tryon, Man. Conchol. 7 (1885) 261.

DOLIUM OLEARIUM (Bruguiére) non Linnæus. Plate 1, fig. 2.

Dolium olearium Bruguiére, LAMARCK, Anim. sans Vert. 7 (1822) 259; REEVE, Conchol. Icon. 5 (1849) *Dolium* pl. 8, fig. 14; TRYON, Man. Conchol. 7 (1885) 262, pl. 2, figs. 8–11; HIDALGO, Cat. Marine Moll. (1904) 153.

Dolium olearium Lamarck var. KIENER, Icon. Coq. Viv. *Dolium* p. 6, pl. 1, fig. 1*a*.

Tonna olearia Bruguiére, FAUSTINO, Bur. Sci. Monog. 25 (1928) 226.

Shell globosely ovate, ventricose, umbilicated; spire but a little exserted; sutures channeled; whorls six to seven, transversely ribbed, ribs broad, close-set, flatly depressed, grooves between ribs narrow and shallow; fulvous-chestnut, maculated with white; interior of aperture dark fulvous brown, whitish towards the lip; lip simple; columella arched, splashed with white nacreous material.

Height, 85 mm; thickness, 66; height of spire, 20; height of body whorl, 71.

Philippines, *Bur. Sci. 1355, 2676 Quadras.* MINDORO, Puerto Galera, *Bur. Sci. 14673 Seale.* MARINDUQUE, *Elera.* CEBU, *Bur. Sci. 14218 Quadras.* BOHOL, *Bur. Sci. 14167 Kelly.* MINDANAO, *Bur. Sci. 1371 Quadras;* Surigao, *Elera.* LEYTE, NEGROS, and JOLO, *Hidalgo.*

Distribution.—Indian Ocean, *Lamarck.*

This species is characterized by white longitudinal markings each paired with chestnut similar to those of *D. deshayesii,* but rather of a different pattern and mode of distribution. The suture is very deeply channeled.

DOLIUM CUMINGII Hanley. Plate 1, fig. 4.

Dolium cumingii HANLEY, Proc. Zool. Soc. (1859) 491; REEVE, Conchol. Icon. 5 (1849) *Dolium* pl. 8, figs. 13*b, c;* HIDALGO, Cat. Marine Moll. (1904) 152.

Dolium olearium var. *cumingii* Hanley, TRYON, Man. Conchol. 7 (1885) 262, pl. 2, fig. 9.

Tonna cumingii Hanley, HEDLEY, Rec. Aust. Mus. 12 (1919) 331; FAUSTINO, Bur. Sci. Monog. 25 (1928) 225.

Shell globosely ovate, ventricose, umbilicated; spire rather short; sutures deep; whorls six to seven, transversely ribbed, ribs nineteen, rather flattened, a little rounded, close-set; grooves distinct; fulvous-chestnut with spiral longitudinally lineated brown and white bands; interior fulvous-brown; columella slightly twisted; lip simple with a slight thickening of white porcelaneous deposit within, somewhat denticulated.

Height, 58 mm; thickness, 48; height of spire, 17; height of body whorl, 50.

Philippines, *Cuming.* POLILLO, *Bur. Sci. 12944 Robinson.*

Distribution.—Australia, *Hedley.*

Tryon, in his Manual of Conchology, placed this species with *D. deshayesii* as varieties of *D. olearium.* However, there seems to be enough difference to warrant the separation of this as an independent species. *Dolium cumingii* is smaller, a bit more globose, the sutures not channeled, and the type or pattern of markings is not similar to that of *D. olearium.*

DOLIUM DESHAYESII Reeve. Plate 1, fig. 5.

Dolium deshayesii REEVE, Conchol. Icon. 5 (1849) *Dolium* pl. 8, fig. 13*a;* HANLEY, Proc. Zool. Soc. (1859) 490; HIDALGO, Cat. Marine Moll. (1904) 152.

Dolium olearium var. *deshayesii* Reeve, TRYON, Man. Conchol. 7 (1885) 262, pl. 2, fig. 10.

Tonna olearia Reeve, FAUSTINO, Bur. Sci. Monog. 25 (1928) 225.

Shell thin, ovate, rather globose, ventricose, umbilicated; spire short; sutures distinct; whorls six, transversely ribbed, ribs twenty-three, somewhat flattened, a little rounded, close-set; grooves distinct; whitish or pale fulvous-brown, painted with bands of white and brown spots; interior of aperture whitish or very light brown; columella slightly twisted; lip simple with a slight thickening of white porcelaneous deposit within, somewhat denticulated.

Height, 59 mm; thickness, 40; height of spire, 19; height of body whorl, 42.

Philippines, *Bur. Sci. 13207 Fulton.*

This species seems to be limited to the waters of the Philippine Islands, where the type specimen was collected by Cuming.

The affinity of this species is more with *D. cumingii* than with *D. olearium;* the general form and character of the ribs are the same, differing only in the distribution and design of the spots, and in the extent of the excavation of the sutures.

DOLIUM ZONATUM Green. Plate 1, fig. 3.

Dolium zonatum GREEN, Trans. Albany Inst. 1: 131; REEVE, Conchol. Icon. 5 (1849) *Dolium* pl. 7, figs. 12*a, b;* TRYON, Man. Conchol. 7 (1885) 263, pl. 3, fig. 17; HIDALGO, Cat. Marine Moll. (1904) 153.

Shell thin, ovately globose, umbilicated, spire a little exserted; sutures channeled; whorls six, transversely ribbed, ribs sixteen, rather convex; grooves broad, those at the anterior portion each decorated with a small rib, those at the upper part with two or three; dark reddish chestnut, spire somewhat lighter, apex

black; interior dark chestnut glazed with a uniform grayish color; columella twisted; lip simple.

Height, 168 mm; thickness, 129; height of spire, 42; height of body whorl, 147.

LUZON, Manila Bay, *Bur. Sci. 14674 Lopez.* Obtained with beam-trawl nets at a depth of 20 to 23 fathoms.

Distribution.—China, *Cuming;* Japan, *Tryon;* Philippines (?) *Elera.*

Reeve noted that "this is the only species of the genus in which there is an isolated raised line between the interstices of the lower ribs of the shell." These are very well marked in the specimens under consideration. In the three spaces at the upper part of the body whorl there are three of these raised lines, a characteristic present only in the young of *D. galea.* This is the largest specimen in the Bureau of Science collection, of a uniform dark reddish chestnut except near the apex. Others are a little more elongated, narrower, and yellowish chestnut.

DOLIUM SULCOSUM (Born). Plate 2, fig. 2.

Buccinum sulcosum Born, DILLWYN, Cat. Recent Shells 2 (1817) 584.

Dolium fasciatum Bruguière, LAMARCK, Anim. sans Vert. 7 (1822) 260; REEVE, Conchol. Icon. 5 (1849) *Dolium* pl. 7, figs. 11*a, b;* TRYON, Man. Conchol. 7 (1885) 263, pl. 3, fig. 16; HIDALGO, Cat. Marine Moll. (1904) 153.

Tonna sulcosa Born, HEDLEY, Rec. Aust. Mus. 12 (1919) 335.

Tonna fasciata Bruguière, FAUSTINO, Bur. Sci. Monog. 25 (1928) 225.

Shell globosely ovate, scarcely umbilicated, spire a little exserted; sutures rather channeled; whorls six to seven, transversely ribbed, ribs nineteen, flatly convex, sharp-edged, rather distant; creamy white, encircled with five broad brownish bands, which fade towards the outer lip; apex dark chestnut; interior whitish, outer lip reflected, fimbriately denticulated; columella a little twisted.

Height, 83 mm; thickness, 63; height of spire, 18; height of body whorl, 67.

LUZON, *Elera:* Manila Bay, *Lopez collection.* MINDORO, *Lopez collection.* CEBU, *Hidalgo.*

Distribution.—Indian Ocean, *Lamarck;* Chinese Seas, *Humphreys;* China and Japan, *Tryon;* coasts of Coromandel, *Martini;* Australia, *Hedley.*

This species very closely resembles *D. allium* and may be very easily confused with it except for the five broad chestnut bands, and the finer and closer-set ribs of this species.

DOLIUM ALLIUM (Dillwyn). Plate 2, fig. 4.

Buccinum dolium var. *B. Buccinum allium* from Solander's MSS, DILLWYN, Cat. Recent Shells 2 (1817) 585.

Dolium costatum Deshayes, REEVE, Conchol. Icon. 5 (1849) *Dolium* pl. 5, fig. 8.

Dolium fasciatum var. KIENER, Icon. Coq. Viv. *Dolium* p. 11, pl. 4, fig. 6.

Dolium latesulcatum Martini, HANLEY, Proc. Zool. Soc. (1859) 489.

Dolium costatum Menke, TRYON, Man. Conchol. 7 (1885) 263, pl. 4, fig. 19; HIDALGO, Cat. Marine Moll. (1904) 152.

Tonna costata Menke, SHIRLEY, Proc. Roy. Soc. Queensland 22 (1911) 98; HEDLEY, Rec. Aust. Mus. 12 (1919) 334; FAUSTINO, Bur. Sci. Monog. 25 (1928) 225.

Tonna allium Dillwyn, IREDALE, Rec. Aust. Mus. 18 (1931) 215.

Shell oblong-ovate, ventricose, slightly umbilicated; spire rather exserted, sutures very slightly channeled; whorls seven, transversely ribbed, ribs thirteen, prominent, somewhat rounded; interstices broad, concave, smooth; creamy white; ribs slightly brownish, apex black; interior white, lip fimbriated, inner border denticulated; columella twisted.

Height, 100 mm; thickness, 71; height of spire, 35; height of body whorl, 82.

Philippines, *Bur. Sci. 13217 Fulton, Bur. Sci. 2687 Quadras.* CEBU, *Bur. Sci. 1343, 11907 Quadras.* BANTAYAN, *Bur. Sci. 13744 Lopez.* MARINDUQUE, *Hidalgo.* MINDANAO, Zamboanga, *Hidalgo.* BASILAN, *Hidalgo.*

Distribution.—Australia, *Hedley.* Dillwyn listed Sicily and Barbary, *Bonnani;* Amboina, *Rumphius;* Philippine Islands, *Petiver;* Senegal, *Adanson;* Tranquebar, *Martini;* very common about Tarentum, *Ulysses.* The writer could not ascertain which of these localities refer to *B. dolium* and which to *B. allium.*

This species with its prominent distant ribs may be distinguished from *D. fimbriatum* by the absence of the brown spots on the ribs, and from *D. sulcosum* by the absence of the five broad brownish bands.

DOLIUM FIMBRIATUM Sowerby. Plate 2, fig. 1.

Dolium fimbriatum SOWERBY, Genera Rec. Foss. Shells 2 (1827) pl. 242, fig. 2; REEVE, Conchol. Icon. 5 (1849) *Dolium* pl. 3, fig. 3*b* (not 3*a*); HANLEY, Proc. Zool. Soc. (1859) 491; HIDALGO, Cat. Marine Moll. (1904) 153.

Dolium lischkeanum Küster, DUNKER, Index Molluscorum Maris Japonici (1882) 57.

Dolium costatum var. *fimbriatum* Sowerby, TRYON, Man. Conchol. 7 (1885) 264, pl. 4, fig. 22; pl. 3, fig. 18.

Tonna fimbriata Sowerby, FAUSTINO, Bur. Sci. Monog. 25 (1928) 226.

Shell globosely ovate, ventricose, slightly umbilicated; spire but a little exserted; sutures distinct; whorls six, transversely ribbed, ribs fourteen, prominent, somewhat rounded; interstices broad, concave, smooth; creamy white, ribs spotted with fawn-brown; apex dark chestnut, interior of aperture brown; lip fimbriated, a little exserted, denticulated within, columella a little twisted, callous anteriorly.

Height, 92 mm; thickness, 69; height of spire, 22; height of body whorl, 78.

LUZON, Manila Bay, *Lopez collection.* MINDORO, Naujan, *Bur. Sci. 1350 Quadras.* BOHOL, *Elera.* PALAWAN, Banga, *Bur. Sci. 14217 Quadras.* CEBU and NEGROS, *Hidalgo.* MINDANAO, Dapitan, *Bur. Sci. 1351 Quadras.* Davao and Zamboanga, *Hidalgo.*

Distribution.—Senegal and Japan, *Tryon.*

This species and *D. maculatum* have been placed by Tryon as varieties of *D. allium.* The shell of the first is more globose, the spire shorter, and the ribs spotted with brown. Reeve, however, noted the difference in the number and character of the ribs among these three closely related species.

Subgenus MALEA Valenciennes

Shell solid, lip thickened, somewhat reflected, denticulated within.

DOLIUM (MALEA) POMUM (Linnæus). Plate 2, fig. 3.

Buccinum pomum LINNÆUS, Syst. Nat. ed. 12 1[2] (1767) 1197; DILLWYN, Cat. Recent Shells 2 (1817) 583.

Dolium pomum Linnæus, LAMARCK, Anim. sans Vert. 7 (1822) 261; REEVE, Conchol. Icon. 5 (1849) *Dolium* pl. 4, figs. 6*a*, *b*; TRYON, Man. Conchol. 7 (1885) 265, pl. 5, fig. 26; KIENER, Icon. Coq. Viv. *Dolium* p. 12, pl. 5, fig. 8.

Malea pomum Linnæus, HIDALGO, Cat. Marine Moll. (1904) 153.

Tonna (Malea) poma Linnæus, FAUSTINO, Bur. Sci. Monog. 25 (1928) 226.

Shell elongately ovate, solid, very slightly umbilicated; spire short; sutures deep; whorls six, transversely ribbed, ribs thirteen to fourteen, prominent, rounded, those at the middle rather flattened; whitish to light fulvous-bay, sprinkled with white and yellowish spots; interior dark orange, aperture somewhat contracted; lip thickened, flatly reflected, denticulated within; columella rudely ribbed, callous, excavated towards the base.

Height, 62 mm; thickness, 45; height of spire, 10; height of body whorl, 58.

Philippines, *Bur. Sci. 13208 Fulton.* LUZON, Bataan Province, Moron, *Hidalgo.* MINDORO, Naujan, *Hidalgo.* MARINDU-

QUE and CEBU, *Hidalgo*. MINDANAO, Zamboanga, *Bur. Sci. 1348*, *Quadras*.

Distribution.—Java, *Linnæus;* coasts of Spanish America, *Bonanni;* Amboina, *Rumphius;* China, *Humphreys;* Red Sea and Indian Ocean, *Tryon;* Indian Ocean, *Kiener;* Society Islands, *Cuming*.

This species is of the *Cassis* form, being solid with the lip thickened, toothed and reflected, and the columella covered with a callosity of white enamel. The excavation at the base of the columella as noted by Reeve is but slight.

Genus PYRULA Lamarck (restricted)

(*Ficula* Swainson)

Shell thin, pyriform, ventricose; spire short; body whorl broad, canaliculated at the base, canal prolonged; aperture elongated, columella thin; lip simple.

Of the nine species of *Pyrula* [6] listed by Faustino six belong to other genera; *colossea* Lam., *lactea* Reeve, and *ternatana* Lam. belong to *Hemifusus; galeodes* Lam. belongs to *Melongena; mawæ* Gray to *Rapana;* and *rapa* Linn. to *Rapa*. Of the three remaining, *ficus* Linn. and *lævigata* Reeve are synonimous, leaving only two species. To these two *dussumieri* [7] was added, giving a total of three valid Philippine species. In Hidalgo's work [8] two species, *ficus* Linn. and *reticulata* Lam., and one variety, *ficoides* Lam., are listed.

PYRULA RETICULATA Lamarck. Plate 2, fig. 5.

Pyrula reticulata LAMARCK, Anim. sans Vert. 7 (1822) 141; KIENER, Icon. Coq. Viv. *Pyrula* p. 28, pl. 12, fig. 1; TRYON, Man. Conchol. 7 (1885) 265, pl. 5, fig. 28; pl. 6, fig. 33; HIDALGO, Cat. Marine Moll. (1904) 154; FAUSTINO, Bur. Sci. Monog. **25** (1928) 227.

Pyrula ficoides LAMARCK, Anim. sans Vert. 7 (1822) 142.

Ficula reticulata LAMARCK, Reeve, Conchol. Icon. 4 (1847) *Ficula* pl. 1, fig. 1.

Pyrula clathrata ROUSSEAU, Proc. Zool. Soc. (1852) 185.

Shell thin, pyriform, ventricose; spire flatly depressed; sutures shallow; reticulately cancellated with sharp longitudinal and spiral ridges, the latter generally alternating large and small; pale yellowish brown encircled with five obscure whitish transverse bands, maculated with reddish brown; interior pale violet; lip simple, columella thin.

[6] Faustino, Bur. Sci. Monog. **25** (1928) 226.

[7] Alcasid, Philip. Journ. Sci. **60** (1936) 423.

[8] Hidalgo, Cat. Marine Moll. (1904) 154.

Height, 70 mm; thickness, 38; height of spire, 5; height of body whorl, 65.

LUZON, Manila Bay, *Lopez collection:* Batangas Province, Taal, *Bur. Sci. 2689 Quadras.* SULU, *Adams;* Jolo, *Elera.*

Distribution.—Indian Ocean, *Lamarck;* East Indies and Japan, *Tryon.*

This species has been erroneously figured by Sowerby [9] as *P. decussata* Wood, while the figure for the true *P. decussata* was described as *P. reticulata.* The specimens figured here show very clearly the reticulately decussated surface of the entire shell; the transverse ridges being alternate coarse and fine striæ; marked with five faint whitish narrow bands and spotted with reddish brown throughout. It approaches *P. ficus* in shape but differs from it by the decussated surface.

PYRULA DUSSUMIERI Valenciennes. Plate 2, fig. 6.

Pyrula dussumieri Valenciennes, KIENER, Icon. Coq. Viv. *Pyrula* p. 25, pl. 11; TRYON, Man. Conchol. 7 (1885) 266, pl. 5, fig. 30; ALCASID, Philip. Journ. Sci. 60 (1936) 423.

Ficula dussumieri Valenciennes, REEVE, Conchol. Icon. 4 (1847) *Ficula* pl. 1, fig. 2; SOWERBY, Thes. Conchyl. 4 (1880) 110 *Ficula* pl. 423, fig. 5.

Shell thin, elongately pyriform, slender, spire short, sutures shallow; transversely ridged, ridges coarse, smooth, rather depressed; grooves distinct, cancellated with fine longitudinal striæ; pale fawn, painted with longitudinal wavy light brown streaks; interior fawn-brown, whitish towards the lip, lip simple.

Height, 97 mm; thickness, 45; height of spire, 8; height of body whorl, 91.

LUZON, Manila Bay, *Bur. Sci. 14660 Lopez.* Collected with beam-trawl nets at a depth of 15 to 20 fathoms.

Distribution.—China, *Cuming.*

A very fine species characterized by its slender form and by the wavy longitudinal light brown streaks. The sculpture of the surface is similar to *P. reticulata* but differs from it by its more elongated form. Hidalgo [10] listed this species as one cited from the Philippines, but decided in the meantime to place it as a Chinese species.

PYRULA FICUS (Linnæus). Plate 2, fig. 7.

Bulla ficus LINNÆUS, Syst. Nat. ed. 12 1[2] (1767) 1184; DILLWYN, Cat. Recent Shells 1 (1817) 484.

[9] Sowerby, Thes. Conchyl. 4 (1880) 110, pl. 423, figs. 1, 2, 3.

[10] Hidalgo, Cat. Marine Moll. (1904) 154.

Pyrula ficus LAMARCK, Anim. sans Vert. (1801) 82; KIENER, Icon. Coq. Viv. *Pyrula* p. 30, pl. 13, fig. 1.
Ficula lævigata REEVE, Conchol. Icon. 4 (1847) *Ficula* pl. 1, fig. 4.
Ficula ficus Linnæus, SOWERBY, Thes. Conchyl. 4 (1880) 109 *Ficula* pl. 423, fig. 4.
Pyrula ficus Linnæus, TRYON, Man. Conchol. 7 (1885) 266, pl. 5, fig. 29; pl. 6, fig. 36 (not 37); HIDALGO, Cat. Marine Moll. (1904) 154; FAUSTINO, Bur. Sci. Monog. 25 (1928) 226.

Shell thin, abbreviately pyriform, ventricose; spire short; sutures shallow; transversely lightly ridged, ridges flat, smooth, spotted with reddish brown, cancellated with fine, scarcely visible, longitudinal striæ; pale fawn encircled with five transverse obscure whitist bands, maculated throughout with broad patches of dark chestnut; interior pale violet; lip simple.

Height, 70 mm; thickness, 44; height of spire, 7; height of body whorl, 65.

Philippines, *Bur. Sci. 13219 Fulton.*

Distribution.—Amboina, *Linnæus;* Red Sea, Indian Ocean, and Singapore, *Tryon;* Moluccas, *Lamarck;* Eastern Seas, *Cuming.*

This species is shorter and more ventricose than the other members of the genus; the surface is so slightly sculptured as to render it rather smooth. The original Linnæan *Bulla ficus* contained two distinct species. Lamarck separated one of them and named it *Pyrula reticulata,* retaining *ficus* for the other. Reeve later "to avoid tautology" changed the name *ficus* to *laevigata.*

ILLUSTRATIONS

PLATE 1

FIG. 1. *Dolium perdix* (Linnæus).
2. *Dolium olearium* (Bruguiére).
3. *Dolium zonatum* Green.
4. *Dolium cumingii* Hanley.
5. *Dolium deshayesii* Reeve.

PLATE 2

FIG. 1. *Dolium fimbriatum* Sowerby.
2. *Dolium sulcosum* Born.
3. *Dolium* (*Malea*) *poma* (Linnæus).
4. *Dolium allium* (Dillwyn).
5. *Pyrula reticulata* Lamarck.
6. *Pyrula dussumieri* Valenciennes.
7. *Pyrula ficus* (Linnæus).

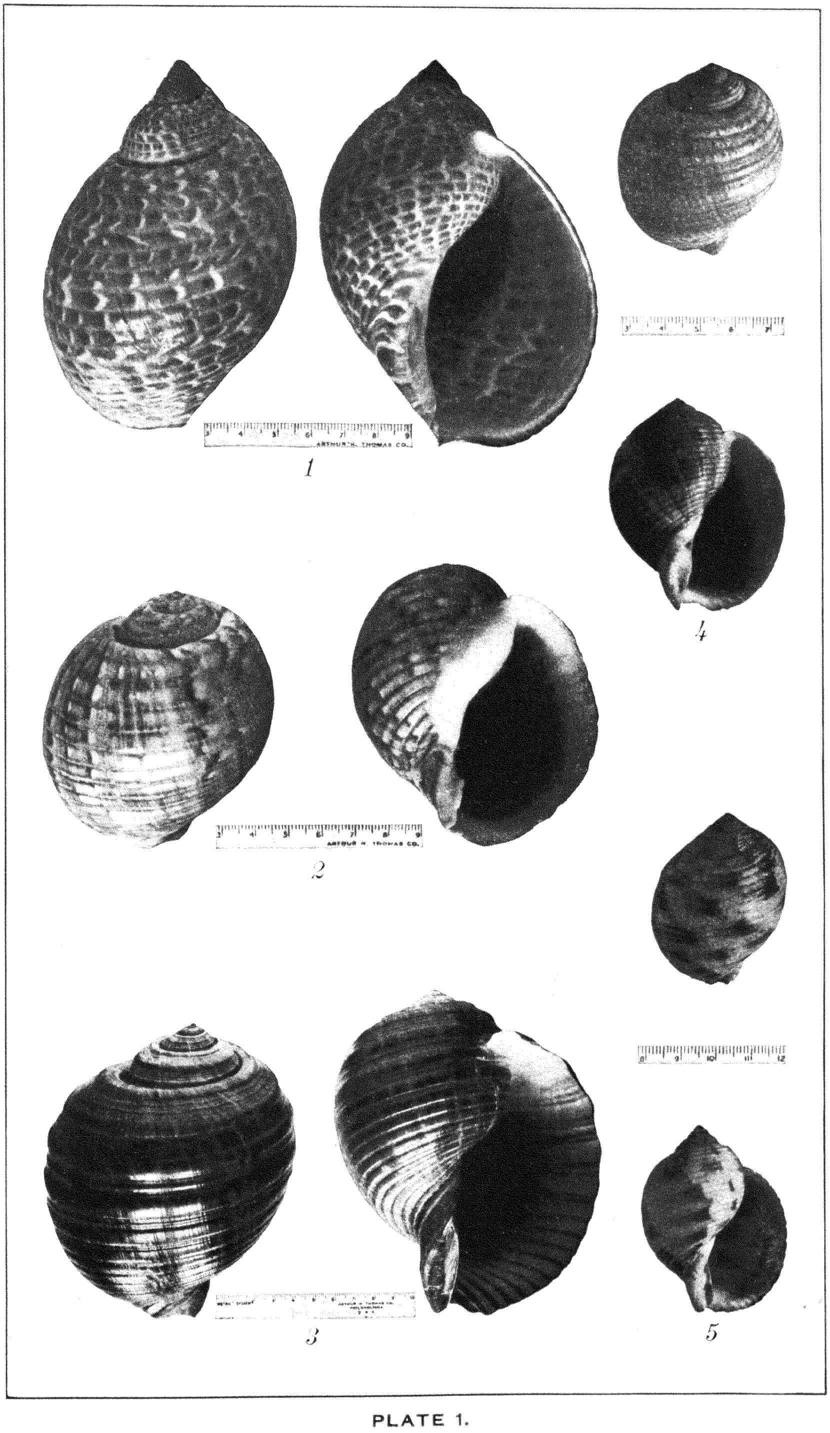


PLATE 1.

BOOKS

Acknowledgment of all books received by the Philippine Journal of Science will be made in this column, from which a selection will be made for review.

RECEIVED

American society for testing materials. Symposium on spectrographic analysis. Philadelphia, The Society, 1935. 51 pp., tables, diagrs. Price, $0.65.

American society for testing materials. Cleveland district committee. Symposium on peralitic malleable cast iron. Philadelphia, The Society, 1936. 22 pp., illus., diagr. Price, $0.60.

BLANCK, A. P. Foods and the law; a manual for the business man and the laws of the United States with reference to foods and food products. N. Y., Peter Smith, 1935. ix + 246 pp. Price, $2.50.

COLLINGS, G. H. Commercial fertilizers; their sources and use. Philadelphia, P. Blakiston's son & co. [c. 1934.] xiv + 325 pp. illus. tables. Price, $3.25.

COOPER, L. F., E. M. BARBER, and H. S. MITCHELL. Nutrition in health and disease for nurses. 6th ed., rev. and reset, Philadelphia, J. B. Lippincott co. [c. 1933.] xiv + 711 pp., illus., tables, fold., diagr., col. plate. Price, $3.

DOWELL, A. A., and O. B. JESNESS. The American farmer and the export market. Minneapolis, University of Minnesota press. [c. 1934.] v + 269 pp., maps, tables, diagrs. Price, $2.

FARRINGTON, BENJAMIN. Science in antiquity. (Home university library of modern knowledge.) London, Thornton Butterworth, 1936. 255 pp. Price, $0.75.

GIFFORD, J. C. The tropical subsistence homestead; diversified tree crops in forest formation for the Antillean area. N. Y., Books inc. [c. 1934.] 158 pp. Price, $0.50.

GLASSTONE, SAMUEL, and A. HICKLING. Electrolytic oxidation and reduction: inorganic and organic. New York, D. Van Nostrand co., inc., 1936. ix + 420 pp., tables, diagrs. Price, $9.

HAIRE, NORMAN. Birth-control methods (contraception, abortion, sterilization). London, George Allen & Unwin, 1936. 192 pp., illus., plates. Price, $1.75.

HATHAWAY, K. A. Modern radio essentials. Chicago, American technical society, 1936. 200 pp., illus., tables, diagrs. Price, $2.

HAVEN, G. B. Industrial fabrics; a handbook for engineers, purchasing agents, and salesmen. 1st ed. New York, Wellington Sears co., 1934. x + 538 pp., illus., fold. plates, tables, diagrs. Price, $2.

HAVENS, L. C. The bacteriology of typhoid, salmonella, and dysentery infections and carrier states. N. Y., The Commonwealth fund, 1935. xii + 158 pp., illus., diagrs. Price, $1.75.

Imperial agricultural bureaux. Vernalization and phasic development of plants. Aberystwyth and Cambridge, Imperial bureaux of plant genetics, 1935. 151 pp., tables. Price, $2.50.

Imperial college of tropical agriculture. Cacao research. 4th annual report, 1934. Trinidad, Govt. print. off., 1935. Price, $2.50.

KARPMAN, BEN. The individual criminal; studies in the psychogenetics of crime. Washington, D. C., Nervous and mental diseases pub. co. [c. 1935.] x + 317 pp. Price, $4.50.

KIRK, G. L. Philippine independence, motives, problems and prospects. N. Y., Farrar & Rinehart, 1936. 278 pp. Price, $2.50.

KOFOID, C. A., and others, ed. Termites and termite control. Berkeley, University of California press, 1934. xxvii +795 pp., front., illus., tables, diagrs. Price, $5.

LEFENETRE, H., and P. DEDIEU. Technique systématique de l'inspection des viandes de boucherie. Paris, Vigot Frères, 1936. viii + 408 + xxix pp., illus.

LULL, R. S. Fossils; what they tell us of plants and animals of the past. N. Y., The University society. [c. 1931.] iv + 114 pp., illus. Price, $0.65.

MAINGOT, GEORGES, RAYMOND SARASIN, and HENRI DUCLOS. Exploration radiologique des colons et de l'appendice au moyen des solutions floculantes images de muqueuses; technique-séméiologie-syndromes. Paris, Masson et cie, 1935. 229 pp., illus. Price, 200 fr.

NOBLE, R. J. Latex in industry. N. Y., The Rubber age, 1936. 384 pp., illus. Price, $7.

OCHSNER, E. H. Social security. Wisconsin, New era library, inc., 1935. xx + 231 pp. Price, $0.50.

PATTEE, A. F. Practical dietetics, with reference to diet in health and disease. 12th ed. rewritten and reset. Mount Vernon, N. Y., 1935. xv + 880 pp., illus., tables. Price, $3.

SEYMOUR, E. L. D., ed. The garden encyclopedia; a complete practical and convenient guide to every detail of gardening. New York, Wm. H. Wise & co., 1936. x + 1300 pp., illus., plates. Price, $5.

SNYDER, T. E. Our enemy the termite. Ithaca, N. Y., Comstock pub. co., 1935. xii + 196 pp., illus. Price, $3.

Success Publishing co. Success; 1500 new economy cookery and household recipes. London, The Author. [n. d.] 256 pp., col. illus. Price, $1.25.

THURSTAN, VIOLETTA. The use of vegetable dyes for beginners. rev. ed., Leicester, The Dryad press, 1936. 51 pp. Price, $0.70.

VAN UVEN, M. J. Mathematical treatment of the results of agricultural and other experiments. Groningen, Batavia, P. Hoordhoff, 1935. vi + 309 pp. Price, $3.75 unbound; $4 bound.

WHITBY, L. E. H. Disorders of the blood; diagnosis, pathology, treatment and technique. Philadelphia, P. Blakiston's son & co., 1935. viii + 543 pp., illus., col. plates, diagrs., tables. Price, $7.

WIESNER, B. P. Sex. London, Thornton Butterworth, 1936. 251 pp., illus. Price, $0.75.

WILLIAMS, F. H. Radium treatment of skin diseases; new growths, diseases of the eyes and tonsils. Boston, The Stratford co. [c. 1935.] iii + 118 pp. plates. Price, $2.

WILSON, G. S. The bacteriological grading of milk. London, H. M. Stationery off., 1935. 392 pp., tables, diagrs. Price, $2.

WOLF, F. A. Tobacco diseases and decays. Durham, North Carolina, Duke university press, 1935. xix +454 pp., illus. Price, $5.

WOLLENWEBER, H. W., and O. A. REINKING. Die fusarien; ihre beschreibung, schadwirkung und bekämpfung. Berlin, Paul Parey, 1935. viii + 355 pp., illus. Price, in Germany, Rm. 18, unbound; Rm. 20, bound; foreign, Rm. 13.50, unbound; Rm. 15, bound.

ZIMMER, FRITZ. Nitrocellulose ester lacquers; their composition, application and uses. N. Y., D. Van Nostrand co., 1934. xv + 246 pp., illus., plates, tables. Price, $7.

REVIEWS

The Chemical Control of Conception. By John R. Baker. With a chapter by H. M. Carleton. Chapman and Hall, Ltd., London, 1935. 173 pp. Price, $3.75.

This book gives a resumé of the results of the author's series of experimental investigations on the action of some chemical substances as spermicides. The author describes the technic, which he has standardized for grading contraceptive agents, and gives the results of the same scientific tests when applied to other substances that may be used for this purpose.

Judging from the net result of his experiments, however, it would seem that the perfect spermicide has yet to be discovered, inasmuch as the really potent contraceptive agent that is devoid of pathological effect has not yet been found.

The author has found that certain substances that reduce surface tension, such as soap, have high spermicidal effect. Thus Castile soap (sodium oleate) has been found as spermicidal as quinine bisulphate, which is twenty-seven times as expensive.

This book enables one to become acquainted with contraceptive materials better than those now available, but less known or only imperfectly understood. This book will be found a valuable addition to existing literature on conception by the physician, the chemist, the pharmacologist, the physiologist, and the biologist.—A. P. W.

A Text Book on Forest Management. By M. R. K. Jerram. Chapman and Hall, Ltd., London, 1935. 156 pp., 17 figs. Price, $2.25.

Written to meet the requirements of forest students, this book brings together, in as brief and simple a manner as possible, all matters of primary importance relating to the subjects which are commonly dealt with under the term "forest management." The author claims that "it is not intended to displace the study

of those authors who deal with these subjects individually at much greater length; but it does represent an endeavor to introduce the students to all the more important problems involved and to explain the elementary principles on which their solutions are based." At most, therefore, the book provides a framework on which fuller knowledge of forest management can be built up by the teacher.

The book is divided into three parts. Part I deals with the foundations of forest management; part II, with the preparation and control of a working plan; part III, with forest finance. In appendix I are found the terms used in forest management as approved by the Empire Forestry Conference in 1928. The values of I, op^n are also found in appendix II.—C. S.

American Conservation in Picture and Story. Compiled and edited by Ovid Butler. The American Forestry Association, Washington, D. C., 1935. 144 pp., 216 illus. Price, $2.50.

This book, which was issued by the American Forestry Association to commemorate the completion of its sixty years of public service in behalf of American forestry, gives a comprehensive and graphic picture of the history of conservation in the United States. The movement to awaken public sentiment in conservation work dates from 1875, the year in which the association was organized, and this volume records the accomplishments largely to be credited to its efforts.

The book was prepared with the coöperation of authorities on the various phases of conservation in the United States and includes such topics as the beginning of forest exploitation, the public domain, the age of wood, the story of lumbering, the National forests, the National parks, the conservation of wild life, the spread of forest education, forest research, and conservation of the soil. The more recent activities under the New Deal, such as the Civilian Conservation Corps and the Lumber Code, are also discussed. A selected reading list of references is given at the end.—C. S.

Wanderings Among South Sea Savages and in Borneo and the Philippines. By H. Wilfrid Walker. H. F. and G. Witherby, Ltd., London, 1935. 254 pp., illus. Price, 7s, 6d.

The favorable reception accorded this book since its original publication in 1909 seems to be the excuse for this second reissue.

The book is a remarkable record of adventure and gives interesting accounts of the author's wanderings among primitive

inhabitants of the South Sea Islands before the World War. Its interest lies in the fact that in giving a general impression of his experiences the author affords an insight into the life of the people visited. As realized by himself, however, in his attempt to be as concise as possible, the author has left out much that might have been interesting. Having no pretension to be "scientific" in his accounts, as he claims, he has therefore touched but lightly on the general customs of the people and has made no special study of their languages. Even such superficial treatment of these two cultural phases of primitive life, however, makes the book a valuable reading material for students of ethnology, besides being an interesting book of travel to others.—R. E. G.

Head, Heart and Hands in Human Evolution. By R. R. Marett. Henry Holt and Co., New York, 1935. 303 pp. Price, $3.50.

A book that affords interesting reading on sociological inquiry is this study by Doctor Marett, rector of Exeter College, Oxford, and one of the leading students of social anthropology and primitive religion. Marett discusses the three fundamental ways of organizing human experience; namely, by means of the head, the heart, and the hands. In part I he brings attention to the question of how to use and to keep one's head in tackling the theoretical problems involved in sociological inquiry; in parts II and III he deals with pretheologic religion, giving illustrations; and in part IV he considers primitive technology or the arts and crafts of prehistoric and primitive man.—R. E. G.

The Duke Forest, a Demonstration and Research Laboratory. By Clarence F. Korstian and William Maughan. Duke University, Forestry Bulletin No. 1. Durham, N. C., 1935. 74 pp., illus., maps.

This publication describes the Duke Forest of Duke University in Durham, North Carolina, the administration and policies controlling its operation, and the progress already achieved. The forest is somewhat similar to the Makiling National Park at Los Baños, Laguna, in that it serves the threefold purpose of demonstration, research, and outdoor laboratory in forestry. The area contains 4,696.1 acres (1,878.4 hectares) 3,411.3 acres of which are covered with forests of various types, stands, and soils. The forest is divided into three divisions containing 114 compartments, with natural or artificial boundaries, ranging in size from 5.6 to 84.5 acres with an average of 40.1 acres.

The management policy aims to make the forest serve as an area for the development and demonstration of forestry prac-

tices, as an experiment forest for research in the problems of timber growing and in the sciences basic thereto, and as an outdoor laboratory where field work can be carried on by forestry students. There are 48 permanent sample plots, ranging in size from 0.1 to 1 acre, for the purpose of studying various problems and to serve as centers of demonstration activities. In managing the forest the aim is to limit the cut within the annual growth, giving due consideration, however, to needed sanitation and silvicultural operations such as pruning, thinning, planting, and removal of defective trees. A very interesting part of the publication is the chapter dealing with the various forms used and the system of keeping forest records. Although the forest is primarily established for demonstration and research, it is also managed as a business, and complete financial record is maintained.

A description of the progress already accomplished in regard to land classification, forest protection, regulation of the cut, and silvicultural operations is given.

This is a handy, well-written bulletin, profusely illustrated with photographs and maps, giving a good idea of the Duke Forest, its present condition, and its possibilities.—C. S.

Kleines Handbuch des Hoch-, Ingenieur- und Machinenbaus. Von Dr. Phil. H. H. Schwanecke. Newmann-Neudamm, Berlin, 1934. Vol. I, cloth, 855 pp., illus., diagram, charts, tables. Price, 25 RM.

The author has successfully achieved the promise implied in the title by this very concise but complete presentation of two major branches of engineering. The book is richly illustrated with figures, diagrams, and charts.

Each subject—mathematics, chemistry and physics, technical mechanics, thermodynamics, and design—is remarkable in its brevity, scope, and clearness. The subject of mathematics is especially notable for the clearness of presentation in no more than one hundred sixty-three pages. It includes forty-one pages of mathematical tables, ten pages of fundamental formulas of algebra and trigonometry, besides a thorough discussion on analytic geometry and differential and integral calculus. Chemistry and physics are very lightly treated, giving only principal information for general use to the engineer. Technical mechanics covers the various technical notations, equivalents, and measuring units, dynamics and statics of rigid bodies, as well as of fluids. Under the general heading of thermodynamics is included a brief discussion of wind pressure. The design of structures is adequately covered.

It is not only a valuable book for the practicing engineer in his everyday work but is also an excellent text when he wishes to review subjects which have become dim in his memory. It is true that there are many excellent American and English texts dealing with the subjects covered by this book, but it always aids greatly in the perspective of an engineer to be also familiar with the German methods and points of view on the subjects covered by this handbook. In many of the engineering fields Germany has pioneered and has remained a foremost authority.—A. A.

Why the Weather? By Charles F. Brooks. With the collaboration of Eleanor Stabler Brooks and John Nelson. Revised and enlarged. Harcourt Brace and Co., New York, 1935. 295 pp., illus. $2.50.

This book is a veritable mine of information for those who are curious about the why and wherefore of the weather. It is purposely written for the popular mind and is attractively presented; it presents just those things which the general public would like to know. It has the further advantage of being thoroughly up-to-date, the revision having been carefully and conscientiously made. Even though it is an American book evidently compiled for an American public, and treats of many things beyond the experience of the average Filipino, such as sleet, snow, ice-storms, autumn and winter storms in general, still even residents of these Tropical Isles can find these topics interesting, entertaining, and instructive.

One might be inclined to judge hastily that the book deals too much with climatological explanations and not enough with weather forecasting, but this is really an error, for if the manifold hints about forecasting scattered here and there throughout the book were collected they would form quite a comprehensive chapter or two. However, Philippine readers should be careful to remember that the forecasting rules are for the United States or for the temperate zones in general and not for the Philippines. We are in an almost entirely different clime, as weather men trained in the former zones sometimes find to their sorrow.

As far as can be judged from a first perusal, facts are accurately stated, with possibly a few minor exceptions. The writer hardly thinks that a definite correlation has been proved between earthquakes and intense cyclones, nor does he think that such a theory meets with the approval of a majority of seismologists. On page 154, at the top, the statement is made that a typhoon commenced at Yokohama, just before the great earthquake and affected Tokyo soon after. As a matter of fact

the storms was already definitely a typhoon August 28 (the earthquake occurred September 1, 1923) in the Eastern Sea, and most probably started some days earlier south of the Loochoo (Nansei) Islands as a secondary to an occluded typhoon which passed near to the east of Shanghai, August 24. It was a typhoon of moderate intensity, and many more intense ones have passed over Japan with no earthquakes resulting. In the light of recent investigations of the Manila Observatory, it is also almost certain that the author's explanation of the origin of typhoons and hurricanes will have to be modified; surges of air on the front between different wind systems seem the essential factors rather than doldrum conditions which of themselves seem capable only of causing local overturning of the air.—C. E. D.

Scientific Results of the World Cruise of the Yacht "Alva," 1931, William K. Vanderbilt, Commanding. Crustacea: Anomura, Macrura, Euphausiacea, Isopoda, Amphipoda, and Echinodermata: Asteroidea and Echinoidea. By Lee Boone. Bulletin of the Vanderbilt Marine Museum, Volume VI. Huntington, L. I., New York, privately printed, November 30, 1935. 263 pp., 96 pls.

This bulletin, the sixth in the scientific series of the Vanderbilt Marine Museum, deals with the systematics of the collection secured by William K. Vanderbilt during a world cruise of his yacht "Alva" in 1931. It is divided into two parts, the first being a report on the Crustacea, the second treating of the Echinodermata. As the group of animals described include many forms that are Philippine, this book will be useful to students of Crustacea and Echinodermata in the identification of Philippine material. This is specially so because of the numerous splendid drawings and pictures of the animals described. By using this text in combination with the work of Roxas and Estampador on the Stomatopoda of the Philippines, with Yapchiongco's on pagurids, and with Roxas's on Echinoidea, one will obtain a comprehensive idea of the extent and classification of the Philippine crustaceans and echinoderms.—H. A. R.

International Bibliography on the Problems of Blood Transfusion and the Theory of Blood Groups, 1900–1933. By Dr. E. Koenig. The Scientific Research Institute for Blood Transfusion, Leningrad, 1935. 226 pp.

There are 4,423 articles included in this bibliography, which have been grouped into 22 main sections and 77 subsections. It claims to comprise the articles which were published throughout the world on the problems of blood transfusion and the theory of blood groups during the period 1900–1933. Only the titles in Russian, German, English, French, and Italian are

printed in the original. Titles in other languages, such as Spanish, Dutch, and Portuguese, are translated into German. Those in Russian have also, in addition, their German equivalents. The material is arranged according to an apt scheme. However, the compiler has taken considerable liberty in abbreviating the names of the periodicals, without having provided a handy means for identifying their full titles. It is doubted that the "Periodica Medica," from which the abbreviations have been adopted, will be available to many readers.

The translation of several titles from their original languages into German makes the latter the predominant language of the bibliography. This makes the compilation of distinct advantage to those who are at home in this language, but not to many who read only English or Spanish.—M. G.

INDEX

[New names and new combinations are printed in **boldface**.]

A

M

N

O